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Contents.

	PAGE
Forthcoming Events	311
A Purchasing Alliance	311
A Prophecy and its Fulfilment	311
Correspondence	312
Notes from I.B.F. Branches	312
Random Shots	312
Coreprints	313
The Book of Artisan	314
The Ellipsoid Furnace	315
The Cupola Furnace	316
Determination of Sulphur in Foundry and Hematite Irons	318
The Phenomenon Incorrectly Termed "Inverse Chilling of Cast Iron"	319
Publications Received	319
The New Lincoln Section of the Institute	320
Iron and Steel Output in October	320
Brighter Spelter Outlook	320
The Application of Pulverised Fuel to the Foundry Industry	321
Foundry Selling Practice	323
Catalogue Received	323
The Corrosion of Light Alloys	324
This Week's News in Brief	325
Contracts Open	325
Company Meeting	325
Personal	325
Obituary	325
Raw Material Markets	326
Reports and Dividends	326

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*)

Forthcoming Events.

NOVEMBER 24.
Sheffield Metallurgical Association:—Ordinary meeting. "Works Progress," Paper by H. T. Hildage.

NOVEMBER 26.
Institute of Metals (Birmingham Local Section):—Ordinary meeting. "The Casting of Tough-Pitch Copper," Paper by W. F. Brazener.

Institute of British Foundrymen.

NOVEMBER 21.
Wales and Monmouth Branch:—Ordinary meeting at Newport. "The Microscope in Metallurgy," Paper by Prof. A. A. Read, D.Met.
East Midlands Branch:—Ordinary meeting at Loughborough. "High-Duty and High-Test Cast Iron," Paper by H. J. Young.
Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. "Non-Ferrous Founding," Paper by A. Hopwood.

NOVEMBER 27.
London Branch (Junior Section):—Ordinary meeting at 49, Wellington Street, London, W.C.2.

A Purchasing Alliance.

A letter received last Saturday from a foundry concern some 30 miles north of London reads: "A traveller who recently called, on being informed by the 'office' that there was nothing we required from him, promptly entered the foundry, found our foreman, and wasted an hour trying to influence him to place an order. We have now struck this firm off our list of suppliers, as we consider this is an underhand practice. As we are sure the same practice occurs at many other foundries, we shall be glad if you will use your influence, editorially, to suppress it." Whilst we certainly agree that the traveller committed a gross breach of etiquette, we think that a strongly-worded complaint to the traveller's principal would have done greater service to the foundry industry. We are well aware that many representatives to-day are highly-trained technicians and they may feel that the buyer fails to appreciate any factors other than commercial evidence such as price and delivery. Naturally, they wish to discuss their business with a technical man. The buyer, on his part, may have excellent reasons for being quite definite that his firm is temporarily out of the market in the lines covered by the traveller's firm. In any case the traveller might be asked to wait whilst a message is sent to the foundry stating that (1) a firm is offering a commodity the price of which is high, low, or standard, (2) stocks are ample, heavy, or light, (3) can any technical grounds exist for immediate action, and if so (4) would you care to see the representative or (5) ask him to confirm data in writing? If the foundry chief thinks that an interview would be a mutual waste of time, the traveller should be told so quite plainly, with a courteous gesture that if in the future conditions change, the firm will receive inquiries. If the foreman decides that an interview is worth while then that should take place in the buyer's office, until it is obvious to everybody that a visit to the foundry would be mutually beneficial. We state this because we are personally aware of the following facts. Several men now selling coal dust are specialists in matters with which they are not connected commercially—one is an expert cupola operator, whilst a second is an authority on machine moulding. Again, we have seen cupolas improved out of all recognition by refractory salesmen. As a general summing-up of the situation, we would impress upon buyers to allow every salesman to receive the impression that it is co-operative consideration which has caused the decision. No excuse can then exist for attempting to go over the head of the buyer.

A Prophecy and its Fulfilment.

The various Presidential Addresses given each year to the different sections of the British Association contain little of direct value to the foundryman but this year that by Sir Alfred Ewing, himself a distinguished engineer, to the Engineering Section has a lesson for all of us. It was given under peculiar circumstances. The recent meeting in London was the centenary of the Association, and at the jubilee of the Association at York, in 1881, an address was given by a famous engineer, Sir Frederick Bramwell. The gas engine was then much in the public eye. There was no public electricity supply, and the steam engine had apparently reached its zenith. Bramwell prophesied the death of the steam engine and its replacement by the gas engine. Of the steam engine he said "I very much doubt whether those who meet here fifty years hence will then speak of that except in the character of a curiosity to be found in a museum." Twenty-two years later, as recently as 1903, he invested a small sum to be paid for a lecture in 1931 on his prophesy and the relation between the steam engine and the gas engine. Now many of us can look back on 1903, yet how lamentably has the prediction been falsified. The gas engine has had a magnificent history both as a prime mover for industrial power, working first on town gas and then on producer gas, finally developing into the heavy oil engine for land and marine work and to the petrol motor for land, air and marine transport. But steam is not by any means dead. Its use has immensely developed, and through the turbine principle it drives engines of vastly greater power, both individual and aggregate, than engineers of 50 years ago could have dreamed. For Bramwell could not take into consideration Charles Parsons, who in 1897 had already demonstrated that turbine propulsion for ships was practicable. How amazing this development has been is shown by the fact that in 1930 over five and a-half million kilowatts of electrical energy were generated by steam turbines in this country, while all other types of prime movers, reciprocating steam engines, oil and gas engines and water-power plant generated less than a quarter of a million units, oil and gas engines alone making up about 1.5 per cent. of the total. And this in no way belittles the gas engine, which has an important part to play and which some engineers claim can work more economically than the big station. The moral is, that it is never safe to predict what is going to happen in this world, and, furthermore, that in all probability something is going to happen. We cannot keep on doing things and thinking things in a traditional way, for things change, and unless we are ready for sharing in them we are apt to wake up and find a world converted beyond all recognition.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Learning from Competitors.

To the Editor of The Foundry Trade Journal.

Sir,—Mr. Eric N. Simons' article No. 9 must be depressing to a sales manager without Secret-Service experience. What an assortment of information the poor man must get!

Where does the other fellow buy his raw materials? Are they cheaper or dearer? How does he run his works? What output has he? And his quoted prices, his discounts, what are they? Is his telephone operator well spoken—and the sales manager, a go getter?

"There is no reason why one should not ask (questions) openly," writes Mr. Simons. Here are two typical queries on a "fundamental" point—price. The article quotes them in indirect speech: "What part does price pay in selling his (*i.e.*, the competitor's) castings? If it is a higher price, why does he still get orders? and *vice versa*." Would any executive seek this information direct? Few would dare and still fewer reply. If this be so, it follows that the desired facts must be garnered in devious ways. One avenue is mentioned—the mutual customer, who is expected to disclose why someone else "gets particular orders." Fortunately many buyers do not lay bare their castings estimates to every importunate inquirer.

Mr. Simons rightly deprecates the "roundabout method of indirect questioning," but the intimate nature of his queries makes this inevitable. Hearsay evidence and scraps of information are not authoritative facts which alone should be the basis of a firm's trading policy.

It is submitted that the main conception of the article is unsound. Intrusion into the intimate affairs of other companies is unnecessary to foster one's own. By all means exchange catalogues, move in trade circles, scrutinise patents, attend exhibitions, read trade journals, join research societies and be alert to profit by their work. Competitors' announcements, too, may be studied, in fact anything that is published, for the world to read, or offered, for the world to buy. But we need not worry ourselves unduly about others and their organisations, achievements or mistakes.

A far healthier rule is to mind one's own business, to mind it intelligently, without prejudice, selfishness and complacency. Instead of building up a vivid "competitor" complex, let us concentrate on working out our own salvation and, as a corollary, allow our competitors to work theirs out, too. It should not be necessary for a rival to spur a firm to self analysis. Mr. Simons mentions methods of delivery. Find out, he advises, any "special features and facilities." Then ask the question, "would it pay to copy." At best, the inquiry would produce half-truths that might easily be most misleading.

If a firm suspects its transport system, let it approach the problem with an open mind, calling in outside experts if need be. The principle is applicable all round. A case in point is the finish of castings. We are exhorted to discover "the extra touches or the touches lacking" in another's output. Far better to overhaul our own conception of finish; to tackle the problem independently; to be determined to see it whole and to see it through. Let us formulate our own standards and set them high. The sales manager may then get on with his own job—sales, unburdened by the problems of his colleagues and the merits of his competitors.—Yours, etc.,

A. Morgan-Williams.

44, Queen's Road, Coventry.
November 14, 1931.

Notes from I.B.F. Branches.

Newcastle.—At a meeting held on October 24, presided over by Mr. F. Allan, Mr. J. K. Smithson, of Middlesbrough, repeated his lecture on "The Manufacture and Properties of Malleable Castings," which we printed in our issue of February 5, 1931. The discussion which followed threw but little light on the general subject of malleable cast iron, owing to there being no foundries devoted to their manufacture in the locality. Mr. Paulin, however induced the lecturer by his questions to detail the making of plaster patterns, to differentiate between the melting of grey iron and malleable, to detail the necessity for prolonged annealing and to show why heavy runners and risers were needed. In his replies, Mr. Smithson expressed his opinion that the rotary furnace would find wide adoption within the malleable industry. He saw but little future for the material as a heat-resisting metal; whilst he envisaged many difficulties in connection with the welding of malleable cast iron, owing to structural alterations through thermal reactions, causing a change in the condition of the carbon and a loss of ductility.

Mr. Paulin and Mr. Fortune were associated in a vote of thanks which was accorded to the lecturer.

The Burnley Section of the Lancashire Branch held a meeting at the Burnley Technical College on November 12, Mr. A. Jackson presiding. Mr. W. Barnes read a 10-min. Paper on the relative merits of studs *versus* chaplets, and an animated discussion followed. Mr. John Jackson then raised the question of the correct tuyere ratio in cupolas, and instanced wide differences in cupolas working side by side which gave identical results in the metal melted per hr. After some discussion the matter was adjourned to a later meeting. The senior students in engineering and the foundry students were present at the meeting, together with Mr. R. W. Stubbs, the Lancashire Branch-President, who expressed his satisfaction at the success of the meeting.

Scottish Branch.—A propaganda meeting with the object of forming an East of Scotland Section of the Branch is to be held in the Heriot Watt College, Edinburgh, on November 21 at 4 p.m. Mr. W. Wallace, managing director of Brown Bros. & Company, Limited, will preside, and Mr. Evan Ross, of G. & J. Weir, Limited, Cathcart, will read a Paper on "Method Planning for Production." The President and officers of the Scottish Branch will participate in the meeting.

"Styles" System of Moulding.

With reference to the item published in our last issue, the inquirer should write to Derby Castings, Limited, Britannia Iron Works, Derby.

The Ford Motor Company is now erecting plant to scrap derelict motor cars at the rate of one a minute. For the past 20 months, states the "Iron Age," scrap has been secured by wrecking old motor cars purchased and delivered by Ford dealers. The present method is to remove all materials of salvaging value, such as glass, leather and tyres, crush the chassis and cut the resulting wreckage to sizes suitable for charging into open-hearth furnaces. Under the new arrangement, instead of being crushed and cut into small parts, the chassis will be thrust into a powerful hydraulic press to be compressed into bales. A conveyor will deposit the bales in charging boxes to be emptied into the new furnace.

Random Shots.

The best show to see when in Town—see foot of column.

* * *

One of the speakers at the annual meeting of the American Grey Iron Institute suggested that the adoption of a new name for grey iron might help in the selling of castings of that material. Such a designation as "Grey-loy," he thought, would be appropriate. The proposal of re-christening cast iron is, of course, not novel. An annoying individual once applied to steel-mix cast iron the term "semi-steel," which ever since has been the germ of pointless controversy and pother as to what percentage of steel added to cast iron justifies one in describing the product as "semi-steel." As if anything could justify so misleading an expression!

* * *

Clearly the proposal emanates from the selling officers of the industry, some of whom apparently nurse the fond belief that the foisting upon cast iron of a species of trade name would marvellously multiply demand and sales and reduce competition to the semblance of a geometric point—all position (also ran) and no magnitude. "Marksman," however, thinks there's nowt like calling a spade a spade. And *his* belief is that any organised endeavour to perform the dodo-trick on the name "cast iron," *i.e.*, universally suppressing it in favour of a coined expression as "Grey-loy," would speedily reveal the repute in which the unpretensive "cast iron" stands in the eyes of the modern buyer.

* * *

The Leningrad branch of the U.S.S.R. Technical Planning Organisation proposes the construction of a metallurgical plant, the annual output of which is planned to be 1,710,000 tons of cast iron, besides some two and a-half million tons of steel! If these 1,710,000 tons really were of cast iron and not of pig-iron (as is intended), the plant in question would require as a minimum a battery of twenty cupolas, working continuously day and night throughout the year, and under normal working conditions the number of men probably would approach 40,000, which certainly would entitle it to be described as some foundry! What a glorious works visit it would make. . . . "Hold hands and follow the green light."

* * *

In the cinema, to see Mr. Chaplin's "City Lights," I saw flashed upon the screen for a few moments a scene in one of Derby's largest malleable foundries—that of Ley's Malleable Casting Company, I imagine. And the disembodied voice of the commentator declared that the castings were being poured at a temperature of over 2,000 deg. C. Well, it's of no use contradicting a talkie record, because it won't stop and listen, so what could I do but sit back and say nothing? Commissionaires are so unreasonable at times.

* * *

Foundry Conversations.

Moulder (eyeing movable reflector newly attached to lamp unit): "What's this 'ere for, guv'ner?"

Foundry Foreman: "A reflector to project light upon the working plane."

Moulder: "Plane? What plane? Aeroplane?"

Foundry Foreman: "Yes, you have to propell'er round. Is that plain?"

Moulder: "What plane?"

Foundry Foreman: "How I explain."

Moulder: "Not so likely! If I have to shove this 'ere shavin' mirror round myself, I complain!"

* * *

The Science Museum, South Kensington—see head of column.

Marksman.

Coreprints.

By F. C. Edwards.

Amongst the numerous "catalytic agents" employed in the production of castings the coreprint may be regarded as one of the most important. Coreprints are not indicated on the blueprint, and are not required on the casting; yet, unless they are properly related to (1) the particular cores they are intended, by their mould impression, to support; (2) the method of moulding the job, and (3) the production of the cores, they may be the root cause of scrap. And this scrap, moreover, instead of being debited to the account of the actual delinquent—the patternshop—is piled (quite as a matter of course) on the back of that notoriously patient scapegoat for drawing-office and patternshop mistakes—the foundry.

Prima facie evidence yields such verdicts as:—"Core lifted!" "Core out of place!" "Wrong core used!" "Crush!" These and similar expressions, if the cause of the scrap which they are intended to explain was traced to its real source, would be found, almost invariably, to indicate merely the secondary effects of which the primary cause was inadequate, ill-fitting, or imperfectly-conceived coreprints. To the same origin it would often be quite legitimate to assign much of the expense of fettling characteristic of cored work. Extensive chipping and grinding, or even machining, is sometimes necessary to remove unsightly evidence tending to show that coreprints do not always deserve to be termed "catalytic agents."

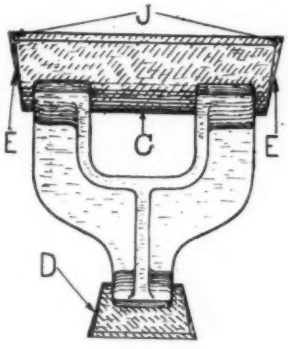

Fig. 1.

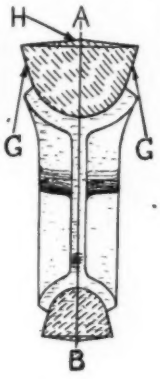

Fig. 2.

It is the patternmaker's business to determine the type and size of the coreprint. Here, sound judgment bespeaks a close acquaintance with foundry practice (the essential prerequisite, incidentally, to all serviceable patternmaking). The way in which he arranges the coreprints of a complicated job, indeed, is a very reliable criterion of the patternmaker's ability. Granted, he may obtain valuable assistance on definite, clear-cut points from the ever-obliging moulder. But he cannot go far as a parasite; he must exercise his own initiative. He must construct the pattern for himself in thought-form, as a modified reflection of the blueprint; he must visualise the sequence of moulding operations as they affect, and are affected by, the coreprint; then, from kaleidoscopic presentations of possible coreprints, tested in position by trial-and-error thought, he must select the one best form to suit the specific requirements of the job in hand.

To obviate, say, a non-negotiable pocket of sand, or some impossible "overhang," he may have to cut down or omit altogether the coreprint here, and balance the deficiency there. Where two or more coreprints occasion risk by their mutual proximity, he may find safety in unity. Above all, he must remember the enormous lifting power of the metal under the core, and so anticipate the moulder's anchorage difficulties. This means that if a difference of permissible bearing surface exists between the upper and lower bearing surface of the core, and anchorage is uncertain, he will arrange, if possible, the coreprint with the larger bearing surface at the top, and that with the smaller bearing at the bottom of the mould (as cast). The latter requires to be merely of sufficient area to support *the weight* of the core; whilst the former must be adequate to withstand the hydrostatic pressure of the metal—several times the weight of the core. The patternmaker must also forestall possible snags likely to beset the moulder as the core is being placed into the print impression, or as the top-part mould is lowered over the core. He must see to it that cores which are generally similar in appearance but not actually identical, on account of some individual peculiarity of detail, have salient, differentiating features embodied in their respective coreprints; and hence, by glaring differences of print impression, leave no ground for doubt in the mind of the moulder as to the required location of each core.

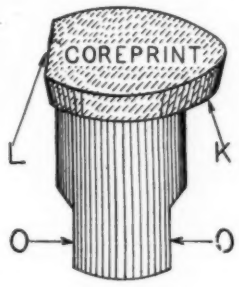

Fig. 4.

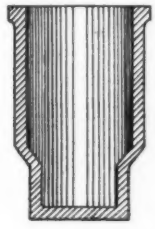

Fig. 5.

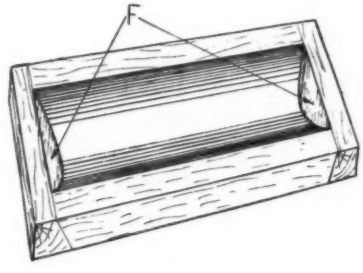

Fig. 3.

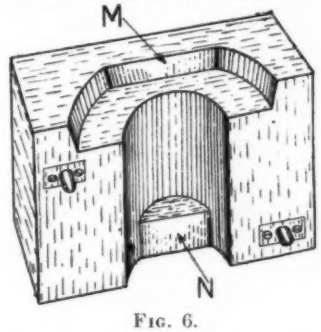

Fig. 6.

Pari passu with the above considerations, the patternmaker should ever bear in mind that the coreprint is reflected in the corebox. The corebox, in turn, should be regarded as an "inside-out" pattern. Wherever it is possible, therefore, the coreprint should be so formed as to help, rather than hinder, the production of the core. Taper, for instance, is just as welcome to the coremaker as it is to the moulder. A core that easily leaves its box is not so likely to come out damaged or distorted as one that needs to be rapped almost to the point of disintegration before it can be extracted. This seems so blatantly obvious that one is at a loss to account for the extreme rarity of the "core-tapered" print—*i.e.*, the coreprint tapered expressly to facilitate the removal of the core from the corebox (in contradistinction to the well-known vertical taper allowed for the withdrawal of the pattern from the mould). Certain it is that, in this direction, the patternmaker's train of thought seldom goes far enough; for whilst he may incorporate the most up-to-date refinements in the pattern for moulding the job, he is often "caught out" by his omission to provide for what really constitute common necessities to the coremaker.

An exemplification of one form of core-tapered print is seen in Figs. 1 and 2. As will be understood by reference to Fig. 2, the pattern is jointed on line A-B. The two bearings at the top are connected by a single coreprint, C. This single coreprint is more effective than separate prints would be—the alignment of the bearings can be guaranteed. The single print also serves as a convenient reinforcement in the construction of the pattern. With regard to the coreprint, D, since it is a reduced facsimile of C, the remarks respecting the latter will apply to the former. It will be noticed that the ends, E, of the coreprint are splayed outwards. This splay neither helps nor retards moulding. But it is very useful in coremaking. A glance at the corebox—Fig. 3—in which the splay is reflected in the ends, F, will make this point clear. The side, outward splay, Fig. 2, again, whilst of no advantage to the moulder, when reflected in the corebox, facilitates the withdrawal of the core.

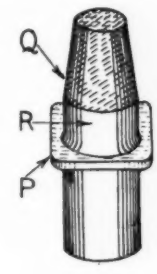

Fig. 7.

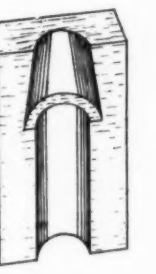

Fig. 8.

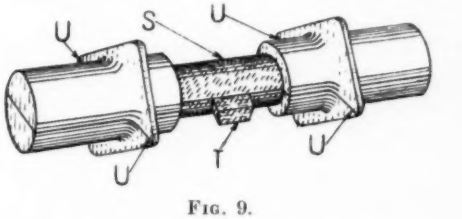

Fig. 9.

Another point of interest is that, whilst the top of the coreprint, H, has a generous moulding taper, the corebox itself is quite flat on its corresponding surface. This taper, though advantageous to the moulder, if reflected in the corebox, would prove a disadvantage to the coremaker. The latter prefers a corebox with a plain, open surface, which enables him to turn out the core upon a flat drying plate. The taper clearance left between core and mould is an advantage in lowering on the top box part. A similar bevel is given to the ends of the prints, J, for the same reason, and is similarly ignored in the corebox. From such a box a perfect core (oil-sand) can be made in a few seconds. Its strong points are accuracy with durability. It

contains no screws which need releasing and replacing with every core produced, and no dowelled joints to get out of order.

In good foundry practice, that method of moulding is chosen which secures the least possible "lift" in the cope. The ideal is the flat top part. This must be kept in mind when determining the type and extent of the coreprint. Where the core is completely housed in the drag, the anchorage problem is simplified, and risk of displacement during the final adjustment of the cope is eliminated. A very useful

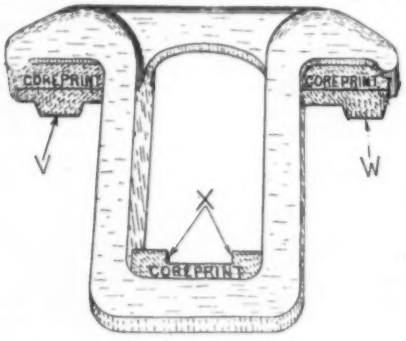

Fig. 10.

form of coreprint that secures the above condition is seen cross-sectioned in Fig. 4, which represents the pattern, as moulded, of the "dead-end" cylinder shown in section in Fig. 5. One half-corebox is seen in Fig. 6. With such a pattern and corebox—properly constructed, of course—perfect location can be guaranteed. It is really a "foolproof" moulding proposition. The flat table top forms an excellent base for the core as it is turned out on the drying plate. Incidentally, gating requirements (not shown in the sketches) may be negotiated with this type of coreprint, and the

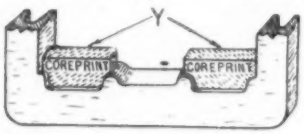

Fig. 11.

cope entirely dispensed with. The projecting ledge, K, provides an ample bearing surface for the core. It should be noted that one side of the (turned) coreprint has been lopped off to produce a definite "flat," L. This "flat" provides the register—reflected in the corebox at M—for the exact orientation of the core, so as to bring the internal bar, N (and its counterpart in the other half-corebox), opposite the recesses, O, Fig. 4.

It often happens (more often than is necessary or expedient, perhaps, from the foundryman's point of view) that the casting is designed in

Fig. 12.

such a way as to rule out the employment of the "flat-top" coreprint. Figs. 7, 8 and 9 illustrate alternative methods of dealing with a case in point. Here the square flange P, Fig. 7, placed some distance down the barrel of the cylinder is "the nigger in the wood pile." This leaves a projection, R, which would convert the simple corebox seen in Fig. 6 into a complicated one. The core is suspended from the cope by the lengthy and well-tapered coreprint, Q. It will be seen that the coreprint, Q, extends to the outer diameter of the projecting collar, R, and thus secures a greater measure of support for the core than would be achieved by merely extending, as coreprint, the internal diameter of the cylinder. The half-corebox, Fig. 8, is self explanatory. Satisfactory production by this method, it may be observed, depends upon the maintenance of a high degree of accuracy in core and coreprint. Not only is their perfect agreement essential, but especial care is required on the part of the moulder if scrap is to be avoided.

A much superior "production" method of dealing with the above type of casting is illustrated in Fig. 9. By this method two castings are expeditiously produced in one mould. The connecting coreprint, S, provides adequate bearing surface for the core, and the location piece, T, ensures the correct endwise position. Incidentally, the pattern is jointed across the corners of the flanges, U, to facilitate moulding.

An example of coreprint differentiation is seen in Fig. 10. This component has right- and left-hand core bearings at the top, and a centre bearing at the lower part of the sketch. The bearings differ from each other, and exact location of each core is essential. As the moulder cores up the job, he can see at a glance that the core with the central projection is intended for the impression formed by location piece, V. The end projection, W, is similarly decisive. In the lower coreprint, the recess, X, secures a true central location for its respective core.

How perfect alignment of separate bearings may be guaranteed is shown by Figs. 11 and 12. With the coreprints as at Y, the chances are that the bearings in the castings will be found out of line with each other. By connecting the coreprints, as seen in Fig. 12, the danger of mal-alignment of bearings disappears. The central projection, Z, ensures endwise location.

The Book of Artisan.

1.—*Of my journey into that part of Britain called the Midlands and my entry into a Foundry wherein castings of Iron are fashioned.*

Now it came to pass at a time that I did journey into that part of Britain which is called the Midlands, upon approaching which country I did perceive many sparks and much smoke belching forth from a tall shaft or chimney that did overtop an high wall of brick. And because of the curiosity that quickened within me I did essay to descry what manner of art did progress behind the said wall. And after much circumlocution I did find myself within the encompassing walls of an old-established Works wherein was melted the metal Iron to be cast into useful shapes; the same works being spoken of as a Foundry.

2.—*Of the Yard of the Foundry, and the great Chaos that did reign therein.*

Now in the Yard of this works, and on all sides of what buildings did comprise the Foundry, I did remark an abundance of what, in mine ignorance, I did believe to be nought but rubbish. Nearby the Gates of the yard was there an heap grown up in main part from old broken Bricks, both of the kind known as Refractory and those used for building. And the moss that did cover them witnessed that the heap was an accumulation of many years.

And beyond the brick heap and the slime puddles which abounded around, was piled much Junk, wherein were many large pieces of iron castings of all shapes and sorts, some of which doubtless had once done high-duty, being scrapped parts of engines and other machines now worn out or obsolete. All these were heaped in great disorderliness and confusion, and in manner dangerously precarious. And amid these heaps of old iron I did perceive many discarded utensils of iron of a domestic nature, the presence of which in such company did appear mightily incongruous unto me.

Likewise, scattered over a wide area in disorder indescribable, I did observe innumerable pieces of iron, nearly symmetrical like unto rough and rusty bars, which pieces of iron I did learn were known as Pigs, the same having been brought from diverse provinces of the country and being of different natures; yet was the last fact neither apparent nor to be inferred from any grouping apart of individual bars; for grouping existed not at all.

Nearby unto the heap of junk, on the far side of an open drain and within easy distance of the Litter of pigs, were many wagon-loads of the fuel Coke, in great plenty, the like of which never have I beheld in any domestic storehouse. And to my astound I did remark that this store of costly fuel was strewn upon the ground with no provision of safeguard from the Elements, and in a manner allowing of no clear passageway for those that did labour in the yard, whereby to pursue their duties without danger of an injured ankle or heavy fall, to say nought of the wetting of one's feet in the puddles that did abound. Moreover, this coke of high worth did share the ground with a disreputable ramp of Ashes and Scoria, mixed with the general Muck of the whole works; and from the latter did arise a far from pleasant smell, which odour stank in my nostrils.

Venturing further, which I did at much hazard, having to tread by way of the coke heap, I did spy out many box-shaped articles of iron, being of both large and small dimensions, and having grids or grilles in semblance of the patterning of dungeon windows. And numbers of these Boxes were thickly encrusted with red rust and in parts were much reduced in thickness by the Elements, being quite exposed, as though their value were but a trifle. Likewise did I remark that many were broken and battered, and many more distorted, so that the Show of the collection was a sorry one. Later was it given me to learn the Usefulness of the said boxes, which men did use as vessels for containing the sand to be fashioned into Moulds, wherein molten iron is cast to assume various shapes.

And the Sand to be fashioned into Moulds I did encounter by the entrance into one of the buildings as an high sand dune wetted by much water. And the rushing of rain water in its eagerness to drain to lower levels had carried much of the sand to other parts of the yard. And I did gather that the sand, like unto the pigs and the coke, of which already I have made record, was brought at much expense from a far-distant province of the land; but now did appear as if of slight value, since no man looked to its preservation. Whereat I did fall to wondering at the sane-mindedness of men who, aware of the weather's unkindness, yet did allow their goods to lie waste and rot in the open.

Automatic Crane Indicators.

A Home Office Order came into force on November 1 in connection with the building regulations in respect of cranes, used in certain building operations, having a fixed jib or a derricking jib. This Order calls for an automatic indicator to be fitted to all such cranes (with certain date reservations) of a type approved by the Chief Inspector of Factories. It is laid down that all such indicators shall show clearly to the operator of the crane when the load being moved approaches the safe-working load of the crane at any inclination of the jib, and shall also give an efficient sound signal when the load being moved is in excess of the safe-working load of the crane at any inclination of the jib.

The only indicator on the market that has been approved by the Chief Inspector of Factories is the Vickers-Nash safe-load indicator, which is manufactured by Vickers-Armstrongs, Limited, at their Dartford Works. By the use of the Vickers-Nash indicator a practical certainty is now available, instead of a doubtful judgment of a crane driver or his "slinger," as to whether a given lift may be safely undertaken.

The Ellipsoid Furnace.

ROTARY OIL-FIRED FURNACE FEATURES DEEP BATH.

We recently had an opportunity of inspecting the Ellipsoid rotary oil-fired furnace working its fourth and fifth casts at the Hollies Foundry of Messrs. Gibbons, Limited, of Dudley. Though new to the British market, the furnace is well known and much appreciated on the Continent. The furnace consists of two cylinders bolted together and mounted at one end on a universal joint, whilst centrally it rests on two roller bearings in such a way as to form a permanent

FIG. 1.—CHARGING SIDE OF THE ELLIPSOID FURNACE.

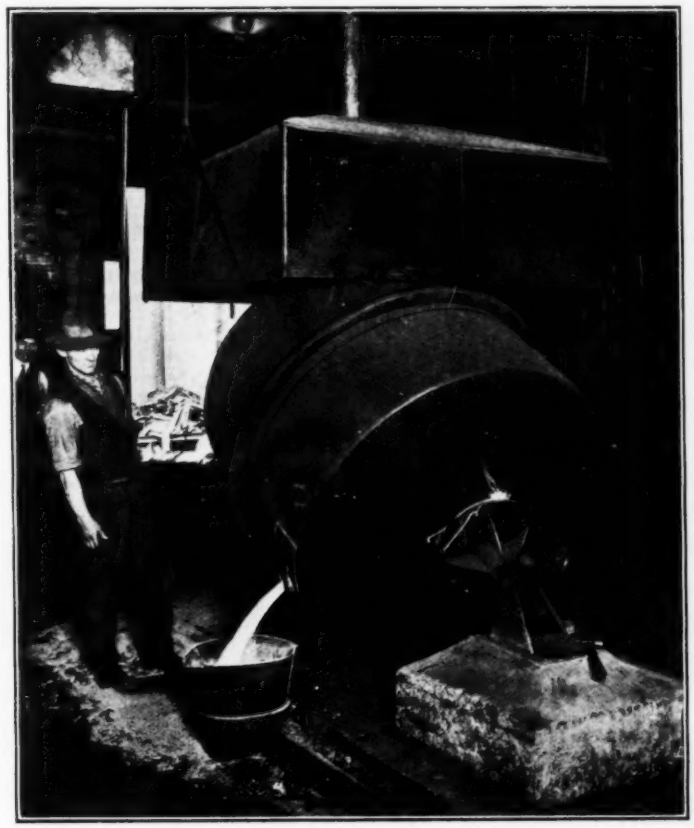

FIG. 2.—TAPPING THE ELLIPSOID FURNACE.

tilt. These features are clearly shown in our illustrations, Figs. 1 and 2. At the front or elevated end the furnace is closed by a circular door which carries the oil burner. It is mounted on the pedestal shown at the left of Fig. 1. This pedestal is hollow and carries the air supply to the burner. The furnace is controlled by the simple switchgear mounted on the column carrying the canopy, superimposed above the furnace for evacuating the products of combustion from the shop. The furnace is rotated by a ½-b.h.p. motor in either direction through a dustproof reduction gear. The tap hole, situated at the lowest point of the bath, is readily accessible, and is as easy to manipulate as an ordinary cupola. Blast is supplied by an Alldays blower driven by a 7½-h.p. motor, whilst the oil is gravity fed from an elevated storage tank. Provision is made for the escape of the gases by four fire-brick-lined circular holes, which provide adequate means for inspection during operation.

For lining the furnace the body is taken from its bearings; the two halves are unbolted. For the bottom half, the base is rammed with a refractory clay or other material according to the ultimate use to which the furnace is to be put. Then a circular template is inserted and refractory material is rammed between it and the cylindrical plate. For the upper half, wooden templates are used to block out the charging door and inspection holes, these cavities later being finished off with special firebrick shapes. The two parts of the furnace body are then bolted together, re-erected into position, and the furnace is slowly dried and finally brought up to melting temperature.

For charging, the oil and air are turned off, the charging door is swung well out of the way, and the materials to be melted, together with their fluxes, are charged in. As soon as the charge becomes pasty, rotation is started and maintained until tapping time.

Metallurgical Features.

By regulating the oil and air mixture, an oxidising, neutral or reducing atmosphere can be maintained in the furnace, and metallic losses kept at a minimum. The heat is communicated to the metal by radiation and conduction of the heat taken up by the lining. Every 40 sec. or so, what was the roof now becomes the hearth of the furnace, and intense convection currents are set up, owing to the depth of the bath. This depth of bath constitutes the main metallurgical feature of the furnace, for it combines all the advantages of the crucible with the accessibility of an ordinary reverberatory furnace, without the drawback of the shallow bath, with its consequent metallic losses. It is thus obvious that the furnace should find a wide field for the melting of non-ferrous metals, especially those containing zinc. Many people imagine that rotary furnaces effect a high mechanical mixing. That is not true; the bath remains as quiet as in a crucible, and it is only during melting down when new surfaces are exposed to the action of the flame. Once melted, the liquid bath is always covered by its slag, and mixing is effected by conduction and convection. Actually, if almost any metal cascaded down a wall continuously we would not be at all satisfied that beneficial results would accrue.

Conclusions.

The furnace which we inspected has had a splendid debut, and so far has given but little indication of any teething troubles. Whilst most oil-fired furnaces have started up on bronze or brass, this one started its career by melting cast iron, and its products have already gone into service. The time taken was 1 hr. 40 min. for a 10-cwt. charge, a figure which should be materially improved upon, as, after all, the fifth charge must be regarded as purely experimental. The furnace, we understand, is now open for inspection by our readers by appointment.

We acknowledge with gratitude the help given and the facilities afforded to us by Mr. M. Van Marle (director) and Mr. Marsh, of Messrs. Gibbons, Limited.

NEGOTIATIONS FOR THE FUSION of important iron and steel interests on the North-East Coast are again the subject of speculation in the daily Press. It has been known for a long time that conversations have been taking place between Messrs. Dorman, Long & Company, Limited, and the Furness group of companies, and it is anticipated that an official statement will not now be long delayed. The companies affected are Messrs. Dorman, Long & Company, the Cargo Fleet Iron Company and the South Durham Steel & Iron Company, and another concern the name of which has not yet been disclosed, but which would be either Messrs. Pease & Partners or the Consett Iron Company.

D

The Cupola Furnace.*

By J. E. Hurst.

The cupola furnace is practically universal in its application to the melting of cast iron for foundry purposes, and this is largely because it has proved the cheapest unit for this purpose. It is for this reason that it has retained its position as the foundry melting unit since the early days of the industry. Very recently this position occupied by the cupola has been challenged principally by the rotary powdered-fuel furnaces, and on the simple basis of the generation of melting heat the use of high-frequency current shows the potentialities of rivalry. For the present, however, the cupola still retains its position. The production of comparative costs of different melting units to demonstrate this is not easy. Recently, however, such a series have been published† in Germany. These figures show the comparative melting costs per ton of material, and as these costs have been determined from the application of each melting unit to the production of malleable-iron castings, their comparative value is increased. The costs have been converted to English values on the basis of the normal rate of exchange. These results are set out in Table I. Accepting in full the details of these comparative costs, they demonstrate that the margin is still in favour of the cupola furnace.

Cardinal Points in Melting Practice.

In spite of this, it is generally admitted that the heat losses in a well-designed cupola are still of a substantial order. Even from the early days, foundrymen, engineers and metallurgists alike have been striving to eliminate the sources of heat loss and effect further economies, with the object of reducing fuel consumption. It is well known that the lowest coke consumption, the hottest iron and the rate of melting solely are not the only criteria of the best cupola operation. Smoothness of operation, freedom from detail troubles, tap-hole trouble, scaffolding, breakouts, operation with the minimum damage to lining and repair work are all equally important in the efficient operation of the cupola. As is the case in many other aspects of foundry-work, these important and fundamental details of supervision, which contribute so much to the successful and efficient operation of the cupola, do not lend themselves suitably for treatment in a lecture. All these eminently practical details must be passed over, therefore, with the knowledge that they are quite safe in the capable hands of the earnest foundryman.

Fuel Economy.

Apart from these considerations, the owner of a cupola principally is concerned with maximum fuel economy. He desires the lowest coke consumption, coupled with a tapping temperature and melting rate sufficiently high for his requirements; in other words, maximum coke efficiency. Consideration has been given to this matter by Thompson and Becker‡ with the object of ascertaining the best possible conditions. These investigators have deduced a relationship which enables one to ascertain the theoretical limit to which the coke ratios can be pushed under stipulated conditions of (*a*) tapping temperature, (*b*) escaping gas composition, (*c*) escaping gas temperature, (*d*) carbon content or ash content of coke and (*e*) heat losses by way of slag, radiation, etc. With a tapping temperature of 1,425 deg. C., escaping gas containing equal volumes of CO_2 and CO, at a temperature of 425 deg. C., and ash content of coke at 12.5 per cent., this limiting coke ratio is 15.4. With the same conditions, but with the escaping gas free from carbon monoxide and at normal temperature, it is possible to obtain a ratio of 1 to 30. In other words, it would be possible to melt one ton of iron with approximately 70 lbs. of coke with an ash content of 12½ per cent. These values, of course, relate to melting coke only. This brief consideration serves to demonstrate the importance of escaping gas composition and temperature and in many cases at least 40 per cent. of the available heat in the coke is absorbed in these sensible and latent heat losses. Many cupolas have been designed with the object of minimising these losses and thus improve the economy of the cupola. Every cupola operator, however, realises that the whole problem is complicated far beyond the comparatively simple considerations of coke combustion by such factors as proportionately of height to diameter; number, shape and disposition of tuyeres; quantity, velocity and pressure of air supply; shape of internal lining; character and composition of the cupola burden; continuity and intermittent operation. That the variations in these factors in individual cupolas are enormous will be admitted by everyone, and this should be sufficient to show that there can be no simple general rule for getting the best out of every cupola.

Air Supply.

Of all the factors which go to influence coke economy that of the air supply is probably the most important, and still the least subject to control in the average foundry. The necessity for control of this factor cannot be better emphasised than by referring to the interdependence of coke ratio, coke consumption and air supply. In practice, for a given set of conditions in a particular cupola there is ample evidence of the existence of a critical quantity of air supply which is accompanied by the best efficiency. The experiments of Piwowarsky and his collaborators provide evidence of this in demonstrating the maximum thermal efficiency and melting rate coincident with a critical blast volume. Further confirmation of this is to be had from Mr. P. H. Wilson's investigation,* which shows clearly the existence of the most efficient CO_2/CO ratio coincident with a critical blast volume. In all these cases the critical blast volume is slightly in excess of the theoretical quantity calculated according to the quality of coke and coke ratio.

The B.C.I.R.A. Cupola.

These brief considerations serve to illustrate the necessity for flexibility of control of the air supply to the cupola. In any cupola plant there is ample control both at the blower end and at the cupola end. In the author's opinion, one of the outstanding features of the B.C.I.R.A. balanced-blast cupola lies in the increased flexibility of air supply control. This cupola is supplied with a row of main tuyeres and two or more rows of small auxiliary tuyeres, all in and fed from the same wind belt. The particular feature of the cupola is that the main lowermost tuyeres are controlled by finely adjustable screw valves, so that the air admitted to these tuyeres may be regulated, the tuyere apertures between the valves and the cupola lining being designed so that, though the annular stream of air passing the valves is at a high velocity, the impinging effect on the coke is reduced so as to produce a softer blast. The construction permits the valve to swing aside in order to get at the tuyere if required, the valve stem being hollow so as to permit inspection and allow of temperatures, gas pressures and gas analyses in the coke bed to be taken if required. The upper tuyeres can also be inspected while the cupola is running.

It is obvious that for a given air-supply pressure the throttling of the valves at the main tuyeres will result in an increase of pressure in the wind belt, and consequently the passage of more air through the upper tuyeres. Thus, a balance of air supply can be maintained between the main tuyeres and the upper tuyeres to suit the requirements of working. It is found that one particular setting of the main valves, readily obtained in practice, is suitable for a particular type of charge, size of scrap, type of coke, etc.

Towards the end of the melt, the necessary reduction of air supply can be obtained by a further throttling of the main valve. When the type of charge, size of scrap, type of coke, etc., is changed, a suitable alteration in the valve openings may be made to obtain the best results. The cupola, therefore, can be controlled by the foundryman to suit any melting conditions which may arise, and after a little practice it is found that beyond the determining of the best valve position for the early part of the blow, no other valve adjustment is needed until, during the last half-hour or so of the blow, the valve openings may be further throttled. Provision is also made for clearing away slag obstruction from the mouth of any tuyere by means of a simple valve, which can be made to cover the inlet to the main valve. After the obstruction has cleared, the de-slagging dish-type valve can be raised and the main tuyere, thus cleared of slag, functions again. When the cupola is running, the valve is, of course, normally above its seat, and is only raised when it is necessary to cut off the air supply, while slag obstructions are melted away. It is of interest to note that on 54-in. bore cupolas of this type a coke consumption of 5.6 per cent. (nearly 18 to 1), together with an increase in melting rate from 10 to 14 tons per hr. has been obtained. If these values are applied to the calculations of cupola-melting costs referred to earlier, they go far to consolidate the supremacy of this type of plant for melting purposes.

"Tuning" a Cupola.

It is of some interest to refer broadly to the procedure to be followed in "tuning" a cupola. The many details of similarity in the "tuning" of a motor cycle or motor car carburettor and "tuning" a cupola will not be overlooked by foundrymen to-day. The plan which has been ably demonstrated by Piwowarsky occupied two principal stages. Firstly, operating with a constant coke ratio under the standard conditions of coke quality, character of burden, height of bed, etc., the optimum conditions of quantity of blast were determined from the thermal efficiencies. For practical foundry working, the maximum melting rate for a given metal temperature can be substituted for the determination of the thermal efficiency. Having determined this blast-volume condition, the second stage consists of steadily varying the coke ratio with the object of determining the lowest limits without decline in tapping temperature. At each reduction in coke ratio the optimum blast volume for the particular cupola is reduced by an amount proportionate to the reduction in coke. This may be followed by a third stage in which the optimum conditions of blast pressure and depth of bed can be determined.

TABLE I.—*Costs shown by various Melting Units producing Malleable Cast Iron.*

CRUCIBLE FURNACE.

	RM.
80 per cent. coke at RM. 31.00 per ton	24.80
Graphite crucibles	30.00
Wood	0.80
Small iron tools, etc.	2.40
Furnace maintenance charges	3.80
Wages	9.00
Melting costs for 1 ton of material	70.80
Amortisation and interest: 15.5 per cent. on RM. 8,000.00 = RM. 1,240.00 on 720 tons of material per annum	1.72
Total melting costs for 1 ton of material	72.52

* Paper presented before the East Midlands Branch of the Institute of British Foundrymen, Mr. T. A. Spiers presiding.

† "Der Tempergus," by E. Shüz and R. Stotz, 1930.

‡ FOUNDRY TRADE JOURNAL, June 24, 1926.

* FOUNDRY TRADE JOURNAL, July 14 and 28, 1927.

CUPOLA FURNACE.	RM.
15 per cent. foundry coke at RM. 31.00 per ton	4.65
Lime, etc.	0.30
Wood	0.50
Electric current for blower	0.40
Small iron tools, etc.	3.15
Furnace maintenance charges	2.10
Wages	3.00
Management melting costs for 1 ton of material	14.10
Amortisation and interest :—	
15.5 per cent. on RM. 25,000.00 = RM. 3,876.00 on 3,750 tons material per annum	1.03
Total melting costs for 1 ton of material	15.13

OIL FURNACE.	RM.
18 per cent. tar oil at RM. 130.00 per ton	23.40
Lime, etc.	0.50
Electric power for blower and ladies	1.20
Small iron tools, etc.	1.80
Furnace maintenance charges	4.20
Wages	5.50
Management melting costs for 1 ton of material	36.60
Amortisation and interest :	
15.5 per cent. on RM. 10,000.00 = RM. 1,550.00 on 1,100 tons material per annum	1.41
Total melting costs for 1 ton of material	38.01

BRACKELSBERG FURNACE.	RM.
20 per cent. coal dust at RM. 20.00 per ton	4.00
Electric current for blower	0.30
Wood	0.30
Lime, etc.	0.30
Small iron tools, etc.	2.50
Furnace upkeep charges	3.60
Wages	2.60
Management melting costs per ton of material.	13.60
Amortisation and interest :	
15.5 per cent. on RM. 55,000.00 = RM. 8,525.00 on 3,600 tons material per annum	2.37
Total melting costs for 1 ton of material	15.97

SIEMENS–MARTIN FURNACE.	RM.
50 per cent. lignite at RM. 17.00 per ton	8.50
Lime, sand, etc.	1.65
Small iron tools, etc.	1.20
Upkeep of melting furnace	4.50
Upkeep of generators	0.30
0.35 ton steam for generators at RM. 6.00 per ton	2.10
Wages	6.30
Management melting costs per ton of material.	24.55
Amortisation and interest :	
15.5 per cent. on RM. 60,000.00 = RM. 9,300.00 on 4,125 tons of material per annum	2.25
Total melting costs per ton of material	26.80

ELECTRIC FURNACE.	RM.
Melting current, 850 kw. at RM. 0.03	25.50
Electric current for regulating electrodes and ladles	0.50
Electrodes at RM. 2.00 per kg.	8.00
Cooling-water requirements (1 cub. m. per 1 st.)	0.10
30 kg. lime at RM. 33.00 per ton	1.05
15 kg. ore at RM. 40.00 per ton	0.60
6 kg. fluorspar at RM. 35.00 per ton	0.20
17 kg. electrode scrap ends at RM. 85.00 per ton	1.45
Furnace maintenance charges	6.40
Wages	4.25
Management melting costs per ton of material.	48.05
Amortisation and interest :	
15.5 per cent. on RM. 120,000.00 = RM. 18,600.00 on 3,750 tons material per annum	4.95
Total melting costs per ton of material	53.00

TOTAL MELTING COSTS FOR 1 TON OF MATERIAL.

	£ per ton.
Crucible furnace	3.564
Cupola furnace	0.74
Oil furnace	1.86
Brackelsberg furnace	0.78
Siemens–Martin furnace	1.31
Electric furnace	2.6

DISCUSSION.

Opening the discussion, the BRANCH-PRESIDENT (Mr. T. Spiers) said he was not greatly enamoured with the balanced-blast cupola. The auxiliary tuyeres increased the depth of the bed coke charge. The special valves for altering the main tuyeres, in ordinary practice, were only necessary when blowing down, and this was quite common practice in the ordinary cupola.

Theory and Practice.

MR. T. GOODWIN, who expressed his appreciation of the Paper, said theoretical figures were unobtainable in practice and were useless. Carbon pick-up was unrelated to coke quality, and it was impossible to pick up more than a certain amount of carbon. The pick-up of sulphur was due to the coke charge. Decarbonising could be ascribed to poor cupola practice. He was sorry that Mr. Hurst had not given any information on "high-duty" irons as melted in the cupola.

MR. HURST said he had not touched upon "high-duty" irons, because he understood that that subject was to be dealt with in the next lecture in the present series. Referring to sulphur pick-up, obviously the pick-up must arrive from the coke. The question was the variation in the amount of pick-up. It did not always follow in step with the amount of sulphur in the coke. In a like manner the question of carbon pick-up was of interest. Whilst there was a tendency to pick up carbon to a certain amount, there were foundries who required less carbon. Some needed 1.0 to 1.5 per cent. silicon with a total carbon of 3.0 per cent. Whether they were wise was not germane to the subject. He knew of one case where a maximum of 3.20 per cent. T.C. was demanded, and castings were rejected because the carbon content was 3.21 per cent. Another foundry used irons of 2.5 per cent. T.C. with the object of obtaining 3.0 per cent., and were distracted because they obtained 3.7 per cent., and it was from that point of view that he suggested that carbon pick-up should be controlled. He had tried to ascertain a cause of this pick-up, and he found that the character of the coke influenced it. With six cokes from different parts of the country, he was able to enunciate the amount of carbon pick-up. Whilst of no practical use, theoretical figures should act as a standard that the foundryman might use. Mr. Goodwin had said they could not be approached in practice, yet the B.C.I.R.A. had got a very close approach to them, as the melting ratio was very nearly 18 to 1.

MR. GOODWIN said that Mr. Hurst had given definite figures as to carbon pick-up. It was possible, in the cupola, regularly to produce irons of less than 2.8 per cent. T.C., as the lecturer had stated.

Direct Blast-Furnace Castings.

MR. P. A. RUSSELL, after thanking Mr. Hurst for a very helpful Paper, asked for the author's opinion on the use of direct blast-furnace metal for castings. On the question of combustion of coke, it was most economical to burn to carbon dioxide. What was the ideal proportion of CO to CO_2 in order to keep the cupola as an efficient unit and reduce oxidation losses? Like Mr. Spiers, he would like to know where the melting zone was in the balanced-blast cupola. Could the author detail any principles for altering the cupola conditions for (1) simple castings, (2) good-quality castings, (3) castings using steel scrap and (4) high-duty irons? Although the author felt he could not trespass on high-duty irons, it would be a very great help. He was not asking for definite figures. Was it desirable to increase or decrease the blast to obtain a minimum of carbon pick-up?

MR. HURST, in reply, referred to the use of direct blast-furnace metal, and said he once did express an opinion, and this was reviewed in the U.S.A. very badly. He was criticised for daring to suggest that this unsatisfactory, old-fashioned method should be revived. He believed there must be some fields of use of blast-furnace metal. With regard to the ideal proportion of CO to CO_2, it was not easy to give figures without due consideration of relation of all the other factors. It might be more guide to take the figures he had shown on the chart, which coincided to the maximum thermal efficiency. These figures were practical ones, in which there was 88 per cent. CO_2 and 12 per cent. CO. There was a most interesting test* on the same cupola with varying coke quantities, varying blast, etc., published by Prof. Piwowarsky. The position of the melting zone of the balanced-blast cupola was undoubtedly much higher than in the ordinary cupola, owing to the three rows of auxiliary tuyeres. Its position could be controlled by the extent the upper tuyeres were used.

Relative Costs.

MR. C. W. BIGG said his main interest in the cupola was in relation of cost to estimate. His hopes were raised by Mr. Hurst and then dashed by Mr. Goodwin's remarks. It is evident that, no matter what the plant was, different results were obtained by different users. We looked on the cupola as the commencement of trouble in the foundry. The figures of cost of the Brackelsberg furnace were most interesting, and it appeared as though the cupola had now to look to its laurels. It did indicate there was a new field open. The capital cost was one of the serious items to be taken into consideration. It was good to have theoretical figures to compare with practical results. It was very interesting to hear of the experiences of Wilkinson, who, Mr. Hurst had related, had conveyed molten blast-furnace metal some distance, by donkey-cart, to cast very light smoothing-iron castings, which were only about $\frac{1}{8}$ in. thick. One of the problems of the modern foundryman was the distance metal had to be conveyed from the cupola to the floor, even with the use of modern handling equipment.

MR. HURST, referring to the subject of melting costs, said he wanted it to be quite clear they were not his figures, but were abstracted from a publication. He had none, and had never before seen any comparative figures. It was worth while to look up these costs. They were set out in full in the book "Der Temperguss," published in 1930. Some 30 or 40 pages were devoted to comparative melting costs, and these went much further than he had indicated.

Carbon Pick-up.

MR. E. STEVENSON, after congratulating the author, said he was interested in the comparative costs of cupola melting and crucible melting. What was the carbon pick-up in the balanced-blast cupola, due to its deeper bed charge? In melting 15 per cent. semi-steel, was it advisable to keep the bed low? By increasing the bed to get hot metal, it would involve a higher carbon pick-up. Mr. Stevenson mentioned a serious quantity of scrap castings he had encountered due to porosity. While discussing the problem with a friend, he was asked whether he had changed his coke, and replied that he had. The new coke was higher in fixed carbon by about 1.0 per cent., which he thought was an improvement, as he got hotter metal. His friend said that that was the trouble; the metal was picking up carbon and so causing the porosity. Mr. Stevenson said it would be a good plan to invite Mr. Hurst to the December meeting in Nottingham, when the present series of Papers were to be re-discussed, so that they could have further discussion.

MR. HURST, referring to the effect of a deep bed on carbon pick-up, said if the question had been asked 12 months ago, he would have said that a deep bed would accentuate carbon pick-up, but he did not feel so confident about it now. The depth of bed might not be so important. He thought the best answer was that

* FOUNDRY TRADE JOURNAL, July 28, 1927, p. 95.

generally there would be a tendency to extra carbon pick-up through a deep bed, but there were cases where there was no extra pick-up. On the subject of 15 per cent. semi-steel, he would advise melting as hot as possible, and he would keep the bed as high as possible.

A Plea for Standardisation.

Mr. Sanders said that some very interesting figures had been shown. One was the melting rate; the greatest melting rate coincided with the highest thermal efficiency, confirming that rapid melting gave the hottest metal, which is an old foundry "saw." Cupolas varied enormously in design according to the ideas of the makers and buyers. For example, with an electric furnace there was specified a definite electrical input, and transformers were installed accordingly, but with a cupola, one might buy a blower separately, and it might be large or small, according to the price the founder was prepared to pay. Cupolas had been made with ratios of tuyere area to area of cross-section of melting zone of from 1:2 to 1:20. The number of rows of tuyeres appeared to be interesting, some still adhered to one row, two rows were common, and the tendency was further to increase the rows of tuyeres, yet he had heard of a cupola with only one tuyere—and it worked!

The thermal efficiency depended on how the coke was burned; by burning to carbon dioxide one obtained three times the heat generated by burning to carbon monoxide. The coke itself had a great influence in this direction, as the burning of coke did not consist of one action. There must be a cone of unchanged air near the tuyeres containing free oxygen and causing oxidation of the metal. Outside this cone there was a large amount of carbon dioxide, formed by combustion of the coke. Above that one was at the mercy of the coke, its reactivity decided to what extent this carbon dioxide would be reduced to monoxide. The chief factor was to obtain the greatest heat in the melting zone.

Total carbon was regarded nowadays as very important; it was certainly quite as important as silicon.

Low total-carbon iron appeared to be worrying quite a number of people, especially buyers. It depended on the class of work; in many cases high total carbon was detrimental; it gave fluidity, but the castings were open grained and weak; 3.3 or 3.4 per cent. probably gave the best results, particularly from the point of view of freedom from porosity. Low total-carbon iron was sluggish and gave difficulty in getting clean castings. The total-carbon content could be controlled in the cupola, and the use of steel scrap helped to lower it. During melting it might be increased or decreased, depending on the depth of coke the iron had to trickle through after melting, its temperature and the time that it remained molten in the cupola. The quicker it was melted and tapped the lower would be the T.C.

Mr. Hurst said an extremely important point was the question of design. He had amplified the point that cupolas did vary widely in design. It was from this point of view of design that he regarded the cupola of the design of the B.C.I.R.A. as most important. Cupola design had been at the mercy of the manufacturer, who was controlled by the idiosyncrasies of the purchasers. The B.C.I.R.A. had performed an admirable service in attempting uniform design, which might form a basis that might prove an important step in the economy of the furnace. Mr. Sander's reference to the researches on coke reminded him of pick-up of carbon. The Coke Research Board had stated the variation of the cokes in reactivity:—that was the behaviour of incandescent coke in contact with CO_2. Coke will dissolve in CO_2. He had suggested that the effect of different brands of coke was that carbon pick-up was proportional with reactivity. There was the possibility that cokes which were highly responsive to reactivity were likely to have greater carbon pick-up.

Mr. Spiers mentioned that he was working a 24-in. cupola and was using 50 lbs. of coke to 8 cwts. of iron, so that he only required another 4 lbs. of iron to be melting at 18 to 1.

Symptoms and Cures.

Mr. R. Orme said he would have liked Mr. Hurst to have given more practical methods of cupola control, such as height of bed, etc. The practical man had not the time to go into the theoretical figures. He did not disagree with the figures, but he thought the symptoms should be given in such a manner that they could be detected immediately.

Mr. Hurst said that Mr. Orme had discovered the crucial point. His remarks could be applied to any profession. For instance, the medical profession would welcome any system of immediately diagnosing the symptoms of a disease to secure immediate cure. He said in his Paper that the question of coke consumption and the like were not the only criteria of the best cupola operation, but though all the troubles were very important, they could hardly be detailed in a lecture. He did not know if there was any method of determining the height of the bed. He knew one old foundryman who used to check the height of his bed by the use of a watch. He used to take the time from the commencement of the blow to the first appearance of a spot of metal dropping at the tuyeres, and he said that the correct bed charge would show metal in 10 min. These practical items were of the utmost importance.

Bed Coke Governed by Time Factor.

Mr. B. Gale said it was interesting to hear of the old foundryman's method of timing the metal. In his works, the system was to blow with the tap hole open until the first spot of metal appeared in the spout, and then they botted the tap hole. For some years past they had found it very good practice to keep a check on the bed height by timing. It was usual in their practice for the time between commencement of the blow to the appearance of metal in the tap hole to take 8 min.

Mr. Hallamore, dealing with the B.C.I.R.A. cupola, said it was interesting to note that the bottom tuyeres point in a downward direction. What was the shape of these tuyeres, and what was Mr. Hurst's opinion of a good shape for tuyeres? General opinion was that splayed tuyeres were the most efficient. Was this correct? What was the ratio of tuyere area to height of stack? In an 18-in. cupola he was able to charge four 3-cwt. charges to fill the stack. Was that high enough, or would it be better to get five charges in the cupola? Had Mr. Hurst any details of methods of testing the temperature of the iron?

Tuyere Arrangements.

Mr. Hurst said the bottom tuyeres of the balanced-blast cupola pointed in a downward direction. They were round, tapered tuyeres of a venturi shape. He preferred a round tuyere, but, generally speaking, he did not think the shape of the tuyere was of major importance. He thought the amount of air, coupled with the pressure and the positions at which it was delivered, were most important. Regarding the height of the cupola stack, it was better to get as much metal into the stack as possible, subject to the cost of raising the metal to the height of the stack. On the subject of measuring temperatures, it was difficult to measure any temperatures higher than 1,000 deg. C. The only practical method was by the use of the optical pyrometer. The results obtained were comparative in any one foundry, but if one tried comparing such results with those taken in some other foundry there were serious discrepancies. Pyrometers of use in the foundry depended on the type of work required in that foundry. There were only a few exceptions where it was necessary to use pyrometers as a routine job. If one had the time to spare for such tests, it would always be beneficial.

Melting Coke Control.

Mr. Armitage said he was convinced that if one burnt 4 in. of the bed for the first charge of metal, assuming correct conditions, and that was replaced by 8 in. of coke between the charges—an excessive quantity—the bed was increased and excessive carbon pick-up resulted.

Mr. Hurst pointed out that in the best-controlled cupola one could not replace the bed coke to $\frac{1}{1000}$ in. Whether that influenced carbon pick-up he could not say. It tended to emphasise how necessary it was to work to schedule.

Mr. Goodwin insisted that no matter whether one started with the bed high or low one could only melt in one place, and could only have carbon pick-up in that one place. Founders could disregard the amount of coke placed in the cupola in reference to carbon pick-up.

Mr. Orme said one could not burn all the coke in the bed, and Mr. Armitage pointed out that one must replace the bed by the amount of coke burnt away, and so keep the bed in the same place; otherwise one would tap different qualities of iron.

Mr. Orme said there was a variation of the melting zone, but that zone was created by the depth of bed. As far as the bottom of the bed was concerned, it only partly burnt away.

Mr. Armitage asked what was the correct depth of the coke charge? Mr. Hurst replied this could be determined from the weight of the coke charge compared with the diameter of the cupola, by the result of experiments. For a 2-ft. 4-in. diameter cupola, the correct coke weight was 0.54 cwts.

A vote of thanks was then accorded the lecturer, and the discussion was adjourned.

Determination of Sulphur in Foundry and Hematite Irons.

On account of the experience of a large ironworks in regard to lack of agreement in the determinations of the sulphur content of low-sulphur pig-irons, such as hematite and foundry iron, the subject was investigated by the Chemical Committee of the German Ironmasters' Association. The usual processes and also some of those proposed recently were tested in six laboratories, the result being published in the Committee's 84th Report in a recent issue of the "Archiv für das Eisenhüttenwesen." Details are given of the six methods employed, two of these, the ether process and the cadmium copper-oxide process, being gravimetric. The other four methods were volumetric, namely, the processes of Reinhardt (iodine), Pinsl (permanganate) and Kinder (calcium iodide and permanganate), in all of which 10 grm. of drillings are dissolved in hydrochloric acid, and the combustion process of Holthaus. In the latter, 2 grm. of drillings are burnt in a strong current of oxygen at about 1,000 to 1,100 deg. C. The irons used in the experiments were a hematite pig with 0.13 per cent. sulphur, and a foundry pig with 0.04 per cent. sulphur. An accuracy of $\pm$ 0.005 and $\pm$ 0.004 per cent. sulphur in the respective cases was regarded as ample.

The two gravimetric processes were found to be practically equally suitable. Kinder's process did not give any advantages over the pure iodine process of Reinhardt, taking longer time. The processes of Reinhardt and Pinsl can be carried out in 45 min. Pinsl's method gave lower values than the others, but with good agreement between the different laboratories. All the processes were found to be suitable for routine work, and the conclusion was drawn that when now and then faulty determinations become evident, they are due to personal errors or to the use of diluted instead of concentrated hydrochloric acid. The Holthaus' combustion process surpasses the others in regard to speed, and may be regarded as a rapid method, giving good agreement with the other processes tested.

The Phenomenon Incorrectly Termed "Inverse Chilling of Cast Iron."*

By L. F. C. Girardet.

In immediate post-war years, cases of inverse-chilled cast iron appeared in foundries everywhere as a new misfortune. A great many investigators tackled the problem, and numerous works were published in which dogma of chilling was respected. The explanation of each differed from the others, and was based upon more or less probable or unlikely hypotheses. This fever quickly abated, however, simply because "inverse chilling" disappeared as suddenly as it had come.

Now that the question has ceased to preoccupy the minds of foundrymen, it can be considered in a more objective fashion. Without delaying to recall and discuss all the hypotheses enunciated, the author will at once postulate his own simple, and by no means hypothetical, explanation of the matter: *The inverse chilling of cast iron, in the conditions where it is produced in the foundry, is not a phenomenon of chilling.* The author has insisted elsewhere on the fact that molten iron is not a homogeneous phase, as is commonly believed, *but a dispersed system*, an emulsion the fineness of which influences its sphere of usefulness. The phenomenon termed "inverse chilling" affords a particularly striking demonstration of this conception, because it shows the separation of the so-called homogeneous liquid iron in two phases which are perfectly distinguishable after solidification: the one freezes in a stable system, and consequently is grey, and the other in a labile system, and therefore is white.

Fig. 1.—Sections of Vertically-Cast Pipe, showing Entrainments of White Iron. (Four-fifths Natural Size.)

The phenomenon of "inverse chilling," therefore, resolves itself quite simply into the following process:—White iron and grey iron are found simultaneously in the ladle, the conditions of temperature, chemical composition, state of dispersion being such that *they are not miscible.* These two irons have nearly the same densities, the white iron being a little heavier than the grey.

At the time of the cast, the entrainments of white iron become localised in sporadic points as a result of the configuration of the mould and the method of running. A layer of grey iron, of which the melting point is higher, solidifies in contact with the interior mould surface, and this layer gets thicker, pressing back the still-liquid white iron towards the interior. The white iron is thus isolated from direct contact with the mould, and obeys by degrees the influence of gravity, so far as the progressive solidification of the grey iron allows, and tends to settle in the lowest parts by compressing and deforming if possible the still-soft grey layer.

There is, therefore, juxtaposition, almost without penetration, of these two layers of iron, but the adherence is perfect, because they wet each other's surface. The boundary between the two is clear, *free from any transition zone* which inevitably should be produced in the case of a phenomenon analogous to chilling.

The following facts justify the author's viewpoint:—In Fig. 1, which shows four pieces of vertically-cast pipe, the white zone is clearly seen, and in pipe No. 3 one can observe the accumulation of white iron in the lower part, hemmed in at the bottom by a thin skin of grey iron. How is this distribution to be explained by any hypothesis of chilling?

Fig. 2 shows a pig used in the iron charge melted to cast these pipes, and its appearance strengthens the author's interpretation. White iron and grey iron, which are not miscible in the prevailing conditions, are tapped simultaneously from the blast furnace. The white iron reaches the bottom of the mould first, and the grey is superposed upon it but without mixing with it. The cupola melting of such an iron, with a temperature lower than that of the blast furnace, evidently cannot effect a cure, and the heterogeneity of the iron is re-encountered in the casting.

A study of the numerous works published upon "inverse chilling" indicates that the investigators, if little in agreement upon the explanations, are in agreement on the following facts:—(1) The delimitation between the two regions is clear, without a transition zone. Micrographic evidence reveals this delimitation, which has been clearly dealt with in the author's earlier remarks, whereas it remains unexplained in the hypotheses incorporating chilling. (2) No fixed ratio exists between the chemical analyses of the two regions—or irons—whereas they ought to be identical and differ only by the structural composition, if they arose from the transformation, by chilling, of the same iron. (3) All the conditions favouring the formation of white iron equally favour the appearance of "inverse chilling." This results quite naturally from what the author has already noted.

In the years 1919-1920, which were the peak years of "inverse chilling," some metallurgists suspected *poor-quality coke* as the principal and almost sole cause. Poor coke, in the blast furnace, would yield white iron, which would be remelted in the cupola in the hope of rendering it grey. Pigs such as that shown in Fig. 2 would be obtained, the hope being delusive, since the heat conditions are not changed. The melter charging such an iron in the cupola, with a coke of no better quality, would aggravate the evil still further.

Finally, one other cause would be the profusion of rusty scrap, used for want of better material; it would give rise to white iron in the cupola and the defect would again be apparent. Circumstances being altered, as soon as the coke again became normal, the defect disappeared and was no longer discussed.

Summing up, the author believes that this defect in castings known as "inverse chilling" is not due to a phenomenon of chilling. It is brought about by inclusions of white iron which have penetrated in the liquid form into the mould and not dissolved in the molten grey iron. It will be produced whenever conditions are such that white iron is found mixed in the liquid state with grey iron, without being able to be dissolved in it.

Therefore it will be necessary (1) to avoid the presence of white iron in the pigs, which should be examined for this; (2) take the same precautions with scrap; (3) suitably work the cupola to avoid the production of white iron, especially at the beginning of the melt; (4) not to charge oxidised or burnt irons, which yield white iron.

The non-dissolution of the white iron in the grey can arise from too low a temperature of cupola working, in the case where the cupola is provided with systems which overdo economy of coke. The adding of a receiver, associated with superheating, is efficacious. It will be necessary, under any condition of formation, to adapt the physical and chemical composition of the charges to cupola working conditions. Certain borderline irons are in loose equilibrium, and can be turned to white by slight influences. The defect will then make its appearance.

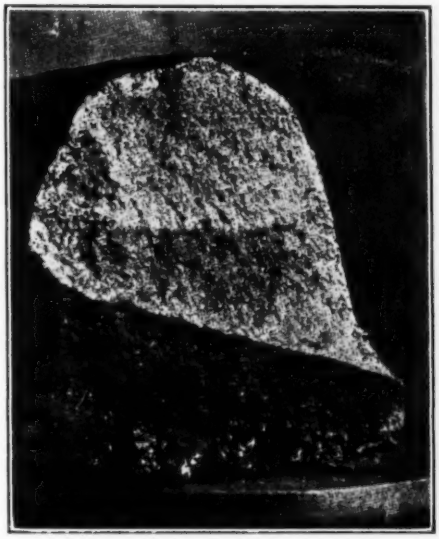

Fig. 2.—Pig used in the Charge for Casting Pipes in which White Iron was present. (Half-size.)

* Abstracted from the "Revue de Fonderie Moderne," October 10, 1931.

Publications Received.

Transactions of the Manchester Association of Engineers, Session 1930-31. Published by the Association, St. John Street Chambers, Deansgate, Manchester.

Of the six Papers reproduced, at least half are directly connected with foundry practice, in fact, two were presented by men prominent in the foundry industry—Mr. E. Longden and Mr. F. W. Rowe. It is a source of satisfaction to the foundry industry that such old-established and reputable engineering institutions as the Manchester Association have now recognised the true position which the foundry occupies in their endeavours.

Proceedings of the Institution of Welding Engineers, Vol. III. Published by the Institution at 30, Red Lion Square, London, W.C.1. Price 3s. post free.

This volume contains eleven Papers, ten of which are of direct interest to the foundryman. One, the "Replacement of Castings by Weldings," by P. L. Roberts, is distinctly provocative, but unconvincing.

The New Lincoln Section of the Institute.

MR. FEASEY'S ADDRESS.

The first business meeting of the newly-formed Lincoln Section of the Institute of British Foundrymen was held in the local technical college on November 7. Mr. J. Feasey, on being requested to take the chair and deliver his address, said his first duty was to tender his sincere thanks for the honour the members had conferred on him by electing him President of the recently-formed Lincolnshire Section of the Institute of British Foundrymen. Its success would depend largely upon the energy and enthusiasm of its members. Here they could meet on common ground and benefit considerably by an exchange of views and so help members to keep themselves abreast of up-to-date methods for their general good. By this means the Section could anticipate years of usefulness and the gaining of a wealth of knowledge.

About 25 to 30 years ago, a small body of people interested in foundry practice considered the necessity of forming an institution which would advance their knowledge, and thereby become a real asset to the foundry industry generally. In recent years the Institute had taken its place as one of the leading technical organisations of the country, and its range of activities expanded year by year. It was, therefore, his desire that, now the Section had been formed, the members would take full advantage of all the Institute offered.

It would be interesting to learn if there were any society or institution formed for the improvement of the foundry trade prior to the formation of the Institute of British Foundrymen, for the craft is an aged and respected science. It dated back to the days when the casting of church bells was one of the principal occupations of the founder, and, in passing, it might be interesting to note that one of these bells, hanging in a church in Moscow, weighed 57 tons. Some were made equal to twice that weight. No bell approaching these in weight existed in England. "Big Ben," cast in the year 1856, weighed only 15½ tons, and was cast by Messrs. Warner, of Durham, at a cost of £3,340.

Old as the craft was, continued Mr. Feasey, there are yet many problems to be mastered, many unexplored channels for its usefulness, each of which would promote interest and enthusiasm in discussion. To-day, the foundry had become infinitely more varied, and far more important to the progress of the world's products than at any other period. If anything was distinguishing us from past history, it was the fact that we were living in an age of mechanical progress. The engineer called for consistency and fulfilment of performance demanding conditions which were incredible many years ago. Here the foundry had demanded assistance from scientific research work and chemists, to discover the properties of rarer metals and to what extent they could be used by alloying. Even the more common elements are carefully investigated for their behaviour, and much has been learned in connection with alloying and melting. Scientific research and daily laboratory reports have been, and will continue to be, indispensable knowledge in the hands of an experienced foundryman who understands that there are peculiarities in founding irrespective of the metal used. Not many years ago a chemist was regarded as a luxury. To-day he was necessary for the production of high-duty castings, and therefore the line of demarcation between science and practical founding is much narrower, for the common good of the whole. All knowledge, be it of a theoretical or practical type, should be applied and discussed with the one object of enhancing the value of the article the foundry produced.

The Section had been inaugurated during a period extremely affected by adverse trade, a condition which had left its mark upon the foundry industry. Whilst the problems of yesterday had been partially satisfied, there were harder and still more exacting problems of to-morrow, demanding solution in the progress of engineering and other industries. Here lies some work for hard thinking, and that is where a solid foundation-training bears good results. It is early training in engineering, science and commercial subjects which cause a man to think clearly and easily, and by the way of a reminder the late Mr. Edison caused a sign to be placed over the laboratory door, reading: "Man will resort to almost any expedient to avoid the real labour of thinking." Hence, it is necessary to support all the efforts being made to train young minds to think clearly of subjects connected with their respective occupations.

There was present a member, Mr. Walters, the principal of the engineering department of the Lincoln Technical College, who had under his care the youth connected with all sections of enginering, and Mr. Feasey believed his efforts would do much to improve those connected with the foundry industry, and eventually benefit the Institute of British Foundrymen.

It was their duty to see that as many of the young men they came in contact with were advised of the opportunities offered by the Institute, and do their best to persuade them to take the fullest advantage of this asset for their future good. The problem did not end with the youth; it extended also to the adult, and to those often of ripe practical experience who took, or appeared to take, no interest in the technical side of their business. The field here was equally important, and the difficulties as great as in the case of the youth. The youth was often an uncertain factor as regards his future, but with the adult we were on sure ground, as he usually possessed in a large degree the vital practical experience and training which might be amplified and enriched by technical knowledge.

Vote of Thanks.

The chairman was thanked for his address on behalf of the meeting by Mr. E. Stevenson and Mr. F. J. Cook. Mr. Cook, a founder and Past-President of the Institute, then addressed the meeting on some elementary aspects of cast iron. After outlining the chemical composition, he explained how the location of the blast furnaces was responsible for the differences in the various brands of pig-iron available to industry. Typical variations were detailed. Some notions of blast-furnace practice were given and comparisons with wrought iron were drawn with the object of showing the general necessity for the presence of so-called impurities. The effect of the common elements on cast iron was described, and illustrated by the use of lantern slides of photomicrographs of typical constituents normally present.

Iron and Steel Output in October.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in operation at the end of October rose to 66, four furnaces having been blown in during the month. The production of pig-iron amounted to 284,200 tons, compared with 248,200 tons last September and 415,000 tons in October, 1930. The production included 53,300 tons of hematite, 118,000 tons of basic, 94,100 tons of foundry and 12,900 tons of forge iron. The October output of steel ingots and castings amounted to 457,400 tons, compared with 400,500 tons last September and 512,500 tons in October, 1930.

Brighter Spelter Outlook.

By "Onlooker."

Spelter has often been referred to as the Cinderella of the metal market, and in the history of this metal there have certainly been periods when the epithet has been deserved. Some months ago, before the abandonment of the gold standard, spelter was "tipped" in some directions as a good buy, but whether many people took advantage of the advice is perhaps doubtful, for at that time demand was very poor indeed, and showed no signs whatever of improving.

Latterly, however, events have moved rather quickly, as some wiseacres foresaw they would, for the way for an advance in values had been well prepared by means of a scaling down of output to the extent of 45 per cent., a rate of reduction which has recently been brought up to 50 per cent. Curtailment to the tune of one-half of the normal output is no small matter, and the first signs of increasing demand have operated to set the ball rolling with considerable vigour, for although stocks of spelter are still very ample, there is definite hope that these will be drawn upon in the near future.

At the time of writing the quotation for this metal has climbed above £14 per ton, a gain of something like £5 from the lowest point touched this year, but part of this advance is, of course, due to the loss of the gold standard. Spelter is "tipped" to go still higher before this year ends, but it is to be hoped that the advance will not be too rapid or too great, for the over-speedy advance brings profit-taking, while production will again be encouraged if the price goes high enough. Many properties are, of course, closed down altogether, and are not likely to reopen until the spelter quotation goes considerably further yet, and, what is more important, gives proof that it can maintain the advance.

A notable feature about the spelter situation is the steady improvement in the general level of quality, as illustrated by the various brands of high-grade or electrolytic zinc on the market, available for sale at a premium of about £2 per ton over the G.O.B. quotation. Canada, Australia and Rhodesia all have a big interest in this high-grade material, and it may be said in passing that the future of commercial spelter seems to be closely identified with this method of electroyltic production. Apparently the output of high-grade zinc is in excess of present needs, for the companies producing this quality are now offering rather lower-grade spelters at a price but little above ordinary G.O.B., which, although not guaranteed 99 per cent. pure, are nevertheless equal to this purity for all practical purposes. This excellence can be readily understood if it be appreciated that the lower-grade stuff is merely a debased variation of the electrolytic quality.

On the consumption side, there is, of course, much leeway to be made up, but there are happily signs that the Eastern markets, which in the past have taken a large tonnage of spelter, are in better fettle, and, should the Indian position be straightened out, this could hardly fail to assist spelter considerably. The demands of the galvanising industry are also increasing, and here again the expansion of Eastern demand would help very materially in improving the call for the metal. Consumption in connection with brass manufacture has latterly been poor, but brassmakers are showing more confidence and, should the copper negotiations be settled satisfactorily, there would be a marked improvement in the call for rolled brass. The manufacture of extruded rod and sections is increasing, and here also we have a better demand for spelter.

Spelter is not out of the wood yet by any means, and "hasten slowly" must be the producers' motto, but it seems safe to say that the tide has turned and that better times lie ahead.

The Application of Pulverised Fuel to the Foundry Industry.

The discussion upon Mr. W. Boon's Paper on "The Application of Pulverised Fuel to the Foundry Industry," presented before the London Branch of the Institute of British Foundrymen and published in our issue of November 5, was opened by Mr. H. C. Dews, the Branch-President, who complimented the author upon his valuable Paper, containing, as it did, so many definite statements, backed up by concrete figures. He also expressed appreciation of the tribute Mr. Boon had paid to the foundry industry in connection with the development of the Sesci furnace. It was not often, he added, that the industry was congratulated upon enterprise in new developments, and a tribute from one so obviously knowledgable as Mr. Boon was very deeply appreciated.

An Engineering Centenary.

Mr. J. W. Gardom (Past Branch-President) pointed out that a hundred years ago this month the first patent for pulverised-coal firing was brought out, and said the fact that its development to the present stage—which Mr. Boon had admitted was not yet perfect—had occupied so long a period indicated lack of push on the part of British manufacturers. It had been introduced by an Englishman—Mr. Dawes, of West Bromwich, he believed—but had been developed in America. The Americans had a type of coal different from that obtained in this country, and they had favoured the central system of coal grinding and distribution, which had many defects. In the first place, it was a very costly system, and was applicable only to big works, so that when pulverised-fuel firing came back to this country it was rather slighted. Another disadvantage from which the development of pulverised-coal firing had suffered was the fact that it was adopted mostly for steam-raising purposes, for which it was supposed to be extremely efficient; the owners of such plant worked a great deal on the peak loads, and the result was that if difficulties occurred with the pulverisers and there was a reduction of efficiency they immediately scrapped the pulverised-fuel system of firing. He had learned only that day that the owners of one of the big power stations in London had taken out pulverised-coal firing and had substituted stoker firing. That was rather a disappointment to him personally, because he was a great believer in pulverised coal.

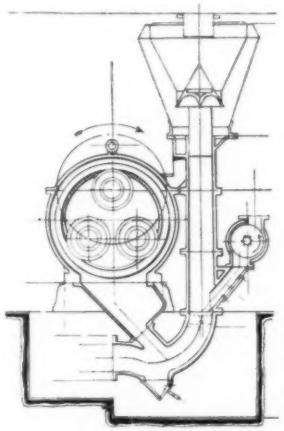

Fig A.—A Typical Ring-Roll Mill.

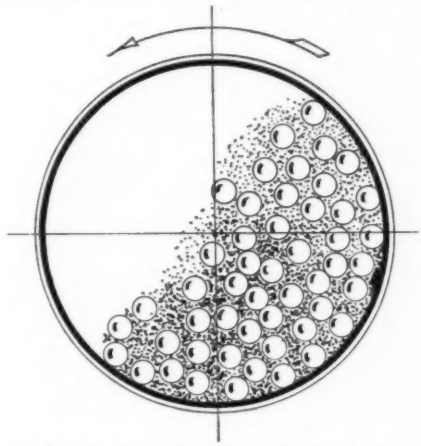

Fig. B.—Showing the Cascading Action in a Ball Mill.

Points about Pulverisers.

Discussing pulverisers, he emphasised that an essential was accessibility to all parts for the purpose of replacement when they were worn. Wear was bound to occur, and one was inclined towards the use of slow-speed pulverisers because the wear in such pulverisers was definitely less than in those in which higher speeds were attained. He believed there had been introduced a pulveriser in which the fines were separated from the coal by air before it went into the pulveriser for crushing, thus saving time and energy which would otherwise be occupied in passing this separated portion through the crushing plant. The coal was also removed immediately it was ground. Commenting upon Mr. Boon's point that the suitability of a coal for burning in the pulverised form depended a great deal upon its ash content, he said that not only the suitability of the coal for burning, but also the life of the refractory, depended upon the ash content of the coal. Having regard to the uniformity of the heat in a pulverised-fuel-fired furnace the refractory used must have a longer life in such a furnace than in one fired by other means, provided, of course, that one took care of the extra heat generated by pulverised fuel. When certain coals were burned, however, there was formed a slag which adhered to the refractory, ate into it and damaged it very quickly. With regard to fineness of grinding, he was glad that Mr. Boon had not urged that all pulverised coal must be sufficiently fine to pass 200 mesh, or that 95 or 99 per cent. must pass 200 mesh. He welcomed Mr. Boon's statement that fuel which would leave no residue on 60 mesh would be suitable for nearly every metallurgical application and would be ideal for boilers, for he believed that, in the past, fineness had been very much overdone. It must be borne in mind that greater fineness meant the expenditure of more power for grinding, and greater cost. The cost of grinding anthracite was definitely greater than that of grinding bituminous coals, because the anthracite had to be ground finer in order to burn. Therefore, he had been rather surprised that Mr. Boon had not mentioned in greater detail other furnaces, such as the Brackelsberg. The Sesci furnace burned anthracite which had to be ground to an extreme fineness and burned with high-temperature secondary air, and he did not think it had any advantage over the bituminous coal-fired furnaces.

Unit *versus* Centralised Systems.

It seemed to him that Mr. Boon had contradicted himself when discussing the unit system *versus* the central system of distribution. When illustrating the central system. Mr. Boon had shown the use of a ring main for carrying the pulverised coal from the pulveriser to serve a number of burners and back again to the pulveriser; later on, however, when discussing the malleable furnace, he had stated that it was impossible to divide the coal and air streams equally when supplying two burners from one pipe. If it could not be done in one case, it could not be done in the other, and the arguments in favour of the central system went by the board if it were impossible to vary the air conditions satisfactorily. He gathered that when discussing the central system Mr. Boon had had in mind big installations such as those existing in America. Discussing the unit system, Mr. Gardom said that its only disadvantage was the possibility of breakdown. Breakdowns were bound to occur, however, in any mechanical apparatus. It was true that in a pulverised-coal-fired furnace the heating was more uniform than in any other, but if a unit broke down so that the supply of coal to the furnace was stopped, the temperature would fall. He suggested, however, that the difficulty might be overcome by some storage system as a go-between, to operate in the event of a breakdown. A small amount of pulverised coal could be stored so that if any grinding unit broke down there would be sufficient pulverised coal available in storage to keep the furnace going for an hour or two while the grinding unit for that furnace was being repaired.

The Case of the Power Station.

Mr. Boon, replying, said that in modern power stations pulverised-fuel firing could show little better efficiency than mechanical stoking, when the costs of pulverising fuel were taken into consideration, unless the price of the coal used in the pulverised-coal-fired system was less than that of the coal used in the mechanically-stoked plant. If he were a power-station superintendent, and had a choice, he would use mechanical stokers for a plant up to a definite boiler size, unless he could use a cheaper coal for pulverised-fuel firing than for stoker firing; the efficiency difference between the two plants was so small that it did not pay the grinding costs, so that the extent of any saving to be effected by using pulverised-coal firing was dependent on the difference between the cost of that coal and the cost of coal used in the mechanically-stoked plant. The power stations in London had not the same advantage as had the power stations in the Midlands, for example, in the matter of obtaining cheap coals. At one time the capital cost of pulverised-fuel firing plant was much higher than that of stoker plant, but at present they are practically equal. The mechanical stoker had a definite limitation in regard to the size of boiler it could deal with, however; it could not, for instance, effectively deal with a boiler giving 30,000 lbs. of steam per hour. During the last ten years the efficiency of mechanical stokers had increased enormously, and he attributed that to a considerable extent to the competition of pulverised-fuel firing.

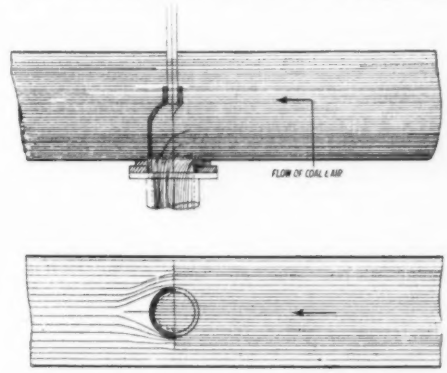

Fig. C.—Showing how the Supplies are drawn from a Centralised Distribution System.

Discussing the grinder referred to by Mr.

Gardom, which provided for the separation of the fines from the coal before it went into the plant, Mr. Boon said he believed Mr. Gardom had in mind a particular ring-roll mill. He illustrated its operation by means of a sketch, and showed how any part of the coal which was fine enough for use without grinding did not enter the mill but was carried past it by the air stream (Fig. A). Hot air could be used at the air inlet. The coal ground in the mill might be returned through the mill many times—perhaps 50 or even 1,000 times—and the mill was very accessible. As a ring-roll mill it was certainly an excellent one, but it was expensive. It had to be stopped for renewals, and he favoured the ball mill because that had not to be stopped; in cement works, ball mills were being run continuously from one week's end to another. Such advantage as there was in separating the fines from the coal before grinding was dependent, of course, on the proportion of fines in the coal, but in normal coal the proportion was not very great.

All ball mills now used in modern pulverised-fuel installations were, he continued, air-swept, and he illustrated by means of a sketch (Fig. B) the barrel of a ball mill, there being a separator at the outlet. Air was swept through the mill and separator, and any over-size coal which might be pulled through with the air stream was separated and taken back to the mill automatically. Even as recently as ten years ago, he said, the ball mill was such that it could not be used in pulverised-fuel installations, because of its very high power-consumption; its development was due to the fact that by air sweeping one could get the coal away from the mill as it was ground. Previously the coal had remained in the mill for an unnecessarily long time; there was a screen at the end of the mill, and the coal had to work its way slowly through that screen. The result was that an enormous amount of tailings which were unnecessarily fine for operation were left in the mill.

As to fineness of grinding, he said that a pulverised coal (from an average mill, either of the ring-roll or ball type) which would leave no residue on 60 mesh would pass to the extent of about 80 per cent. through 200 mesh. With such a fuel, 95 per cent. of all metallurgical applications would be successful. It was important to specify, however, that the material must be the product of a grinding mill, because a coal pulverised in an impact mill, and which would leave no residue on 60 mesh, would probably leave a considerable residue on 100 mesh.

The cost of pulverising anthracite was about 25 per cent. more than the cost of pulverising ordinary bituminous coals, but he believed that 140 deg. greater heat was obtained from anthracite than from the ordinary bituminous coals. The first mills used to pulverise the coal for the Sesci furnace were a failure; they were of the impact type. At one British works they used a compound mill, but he believed they would adopt a ball mill, and there was no doubt that that was the right thing to do.

He disagreed with the suggestion that he had contradicted himself when discussing the central circulating system *versus* the single-pipe unit system. He illustrated his point by means of the sketches (Fig. C), and said that where there was a single supply pipe from a feeder he did not claim that there was equal distribution of air and fuel in two burners, but where there were two burners feeding one combustion chamber, the combustion chamber served as a compensating device and balanced out the inequalities. With the circulating system, where there was a ring main supply, there was a stream of fuel and air which was definite and uniform; for every 1 lb. of coal circulating there was 50 or 60 cub. ft. of air, and the proportions remained constant, so that the furnaces supplied from the main always received air and coal in the proper ratio. Equality of distribution was maintained by means of baffles, as shown in Fig. C. The patents in respect of this method of distribution had expired, and it was installed in very many types of works; in one steel plant a ring main served 166 furnaces of different types.

In a ring main, of course, the heavier particles of coal would go to the bottom of the section of the pipes, whilst the lighter particles of coal, and the air, would be at the top, so that, unless precautions were taken to prevent it, the first burners fed from the mains would receive all the over-size particles and the last burners would receive the best of the fines. Therefore, a baffle was inserted in the pipeline for each burner, and ensured a supply of a fairly uniform mixture of coal and air to each burner. There was also a control and cut-off valve. A baffle was altered only when a furnace was put on or put off; it could be adjusted to give a greater or lesser mixture.

Mr. Gardom asked whether, when a baffle was altered, all the other baffles on a ring main would also have to be altered.

Mr. Boon replied that that was not the case, an alteration being made only when a furnace was started and when it was stopped. The purpose of the baffles was to secure uniformity of the mixture flowing through the pipe, the quantity flowing through was the same always.

Mr. W. B. Lake (Hon. Treasurer of the Institute) asked if the baffle extended right across the section of the pipe.

Mr. Boon replied that it extended vertically upwards from the bottom of the section of the horizontal pipe, but did not extend right to the top.

Mr. Lake said he had asked the question because, if the baffle did extend right across the pipe, it would choke the pipe.

Mr. Wesley Lambert, C.B.E. (Past-President of the Institute), asked if there were in existence an installation using pulverised fuel for melting non-ferrous metals in the open-hearth furnace.

Mr. Boon replied that he had known of three experiments in this connection, two of which were failures, and he believed the third was indifferently successful. Trouble was experienced with the chequers, he believed. So far as he knew, the only furnaces actually running in this country of the reversing regenerative type were three furnaces at the Cordes Dos Company, Newport. They were regenerative and reversing, and had been converted from gas firing. The chequers were opened up from 3 in. on gas to 8 in. on pulverised fuel.

Mr. Lambert asked whether, in these cases, there was direct injection of the pulverised fuel into the melting zone.

Mr. Boon said there was. The air from the chequers came in tangentially. A hole was made in the plates at the large end of the furnace, and the chequers were opened up.

Mr. Lambert said that the pulverised-fuel-fired installations he had seen in operation appeared to have very large combustion chambers.

Mr. Boon agreed that the combustion chambers of boilers were large originally, because we did not really understand the proper ratios to employ or the value of uniformity and fineness of grinding. Normally very few furnaces required alteration when adapted for pulverised-fuel firing, apart from the small alteration in the bridge and the taking away of the firebars.

Mr. Lambert also suggested that, in view of the very considerable wear on the pulverisers, as mentioned by the lecturer, there must be an appreciable quantity of very finely-divided iron associated with the ground fuel, and he asked whether such iron would be carried over with the fuel into the furnace.

Mr. Boon replied that he had not investigated that problem.

Mr. Lambert recalled Mr. Boon's statement that the power required to drive a ball type of pulveriser when running light was practically the same as when it was actually pulverising fuel, and he asked for comparative figures of the power required to drive, under light and load conditions, the ball type and the other types of pulverisers described by the lecturer.

Mr. Boon replied that it was very detrimental to run a ring-roll grinder or even a ball mill empty of product, because the wear was greater when they were running free than when grinding. The power consumption of the ring-roll mill was less than that of the ball mill, because the ring-roll mill was better balanced, but it was very little less. The average power consumption on a 5-ton ring-roll mill was about 14 kw. per ton; a figure of 9 kw. per ton had been achieved, but it was exceptionally good. The power consumption on the smaller sizes of ball mill was sometimes as much as 20 kw. per ton, but on the larger sizes it could be reduced to about 12 kw. per ton. He had never seen a ball mill do more than a ring-roll mill for a given power consumption.

A Vote of Thanks.

Mr. A. W. G. Bagshawe proposed a hearty vote of thanks to Mr. Boon for his very fair and straightforward review of the applications of pulverised-fuel firing in the foundry industry.

Mr. V. Delport, seconding, said he had seen several installations of pulverised-fuel-fired plants on the Continent, and particularly in the Ardennes—the French foundry district. One was installed in a relatively small foundry, the owner of which had spent a lot of money on the installation, and seemed very happy with it. In another case, also in the Ardennes, a little trouble had been experienced with the pulverised-plant, but the owners had intended to modify it. He had seen other installations in Italy and in Czecho-Slovakia, and, under the conditions in which they were working, everyone concerned seemed very satisfied with them. There was certainly something in the process, and Mr. Boon's Paper would be very valuable to founders who had problems to solve in connection with it.

The vote of thanks was carried with acclamation.

Mr. Boon, responding, recalled that much trouble had arisen in connection with pulverised-fuel-fired installations when the system was first applied, but as the result of the experience gained since that time, there were very little teething troubles with the later plants. The men seemed to like the system and were working the plants admirably. With melting furnaces particularly, there was not a single trouble as a rule; the men had to nurse them for a week or two, of course, but after that the furnaces had worked splendidly.

Continental Steel Combines.

The fate of the Continental Steel Cartel is still undecided, owing to the uncertain economic conditions and the depression in the steel export markets. The present provisional arrangement is being continued at the suggestion of the managing committee.

It is stated that a conference is to be held in Paris to consider the question of re-constituting the former syndicate for wire manufactures. An agreement already exists between Belgian and German makers in regard to the export trade, and efforts are now being made to extend this arrangement so as to include producers in France, Holland, Denmark and Czecho-Slovakia.

A New Steel Sleeper.—The Great Western Railway are to try a new type of sleeper on a stretch of line near Twyford Station, which it is claimed will appreciably lessen maintenance charges. The new sleeper and chairs are made in one from a rolled steel plate, with two U-shaped sockets in which the rails rest. All bolts and nuts are avoided. The sleeper is made by the Ebbw Vale Company.

Foundry Selling Practice.

By Eric N. Simons.

(*Continued from page* 291.)

No. 10. SALES PROMOTION TELLS IN DEPRESSED TIMES.

Sales promotion is a somewhat unfamiliar term in this country, and is too often assumed to be another name for sales management. It is, of course, a branch of selling, and should be under the control of the sales manager, but it consists primarily of activities for which the sales manager as a rule has inadequate time. Its main concern is the exploration of new markets, the extension of old, the safeguarding of accounts in existence already, and the dissemination of news and information of value to the business.

The four principal branches of the work of sales promotion are as follow:—(1) Discovering new customers and markets; (2) preventing customers from going elsewhere; (3) feeding information to all branches of the selling force, and to producing departments; and (4) writing circular and special letters to groups of potential customers. Nowadays, the need for new and important markets and customers is even greater than usual, and sales promotion has a value of corresponding dimensions.

Taking (1) first, this is, in a general sense, sales management work, and that branch of it that concerns personal investigation of new territories, development of new markets, finding of new products, etc., must always be left to the sales manager. But there is a good deal of work for which the latter has no time, but which should, and can, be done, preferably by the sales promotion department.

For example, one plan is to examine thoroughly every journal received. Many Government Departments and foreign governments advertise their requirements and invite tenders. It is the sales promotion department's task to look out for these advertisements and ensure that tender forms of interest are written for and received. Again, technical and other journals often receive requests from their readers to be put in touch with the makers of various products. The department writes to the journals in question, when its own firm's products are mentioned, asks to be put in touch with the inquirer, and offers suitable commodities either directly or indirectly. Quick action of this kind often results in the establishment of sound and long-lasting connections.

Another branch of sales promotion work is the daily examination of the firm's order-lists. Each department sends to the sales promotion department a list of its orders for the day. These are gone through, and classified according to the type of firm placing the order. Thus, if stainless steel is ordered by a moulding-machine maker, it is assumed that marine pump makers have a use for stainless steel. A list of all marine pump makers is then got together from various sources, classified according to areas of representation, and the respective lists for each area sent to the respective agent or representative. He is informed that these people are all potentially in the market for stainless steel, and asked to call at least once to ascertain what prospects of business exist.

No attempt is being made to give here a complete record of every detail of work that comes under section (1), on account of space considerations. Passing to section (2), the retaining of accounts, one way in which the sales department attempts to do this is by going through the sales records weekly, and picking out firms from whom no order has been received for six months (or any other suitable period), and who have not been called upon by the representative within that period. A list of these firms is sent to the latter, and he is asked if he has any objection to a special letter being sent to these people, asking why they have ceased to order. If he objects in any particular instances, he is asked his reasons, but no compulsion is exerted upon him. If he agrees, the firms are written to courteously, asking if the goods gave satisfaction. In about 10 per cent. of instances repeat orders follow. In another 10 per cent. unsuspected complaints are made which can often be investigated and put right; in a further 20 per cent. of instances it is found out why the orders were lost. All this is most useful information.

There remains a number of firms whom the traveller does not wish to be approached by letter, yet on whom for some reason he does not call. These firms are carefully considered, and if good people, they are put on to a "dormant accounts sheet," which is sent to the appropriate representative about twice a month on the average. It is seldom that more than four names are included on any one sheet, and the representative is asked certain questions about them, *e.g.*, what they can order, what their financial status is, etc. He is expected to go and see them within four weeks from receiving the sheet, and his report has to be made on the sheet itself. In this way customers are not neglected.

Turning next to section (3), the feeding of information to all branches of the selling force, one must revert to the examination of periodicals alluded to earlier in this article. Representatives are sent lists of contracts of importance placed with firms in their districts. This enables them to plan their journeys according to the state of trade in particular districts and with particular firms. This information is all obtained either from journals or from private sources of information. For example, if a firm gets an order for forging presses, it will need steel castings. The foundry salesman can go right ahead and push for the inquiries. It quite often happens that these notes of contracts are already known to the representative when he gets them. That does not matter. No harm has been done, and experience shows that in a percentage of cases the notes constitute genuine news.

Lists of new companies formed are also valuable. The amount of capital and the type of business is invariably stated, and a note to the representative of new works or firms in their districts gives them an opportunity of getting in first with new customers.

Then there is information concerning the restarting of works which have been closed down. When a salesman calls on a firm and finds its works closed, he tends to cross it off his list. But that works may reopen a few months later, or a new company may take over the old. In the meantime, because he thinks of it as still shut down, he does not call. Another salesman goes along and gets the business. Obviously, it is sales promotion work to look out for these notices of reopenings and advise the salesmen of them. Notes of pending or actual amalgamations or removals of works are also of value to representatives.

Then there is another activity of great importance. This is the close and thorough study of articles on new products or machinery manufactured by various firms. It often happens that in the course of the specifications or technical descriptions which usually form part of these articles, some casting or other is mentioned as an integral feature. Here is the sales promotion department's cue. It writes at once to the representative in the producing firm's district, saying that here is a firm using such and such a product for its machine or appliance. He should make a point of calling and trying to get the orders for this commodity. For example, a description of a new type of stove may mention that heat-resisting steel parts have been used in place of cast iron where growth occurred. Here is a chance for the maker of heat-resisting steel to step in and advocate his own product.

Information of use to producing departments can also be gathered by the sales promotion department. Indications that new competitors are coming into the field, descriptions of competing products, notes of performances advertised by competitors—which can often be excelled by the firm concerned—and similar items of news, are all valuable and necessary.

Intimations of schemes afoot for road development, or cement manufacture, or oil-well drilling, or railway making, are all contained in periodicals, and advance information of this kind enables agents to explore the prospects and to be in touch with the right people from the start. Modern firms make it their business to collect and disseminate just this sort of news.

(*To be continued.*)

Catalogues Received.

Grinding Wheels.—One of the most intelligent pieces of publicity matter to reach our hands for a long time is "Recommendations on the Selection and Application of Grinding Wheels," just issued by the Carborundum Company, Limited, of Trafford Park, Manchester. The opening fifteen pages constitute a veritable text-book on how to use grinding wheels so as to ensure maximum serviceability. We use the word serviceability in the sense of doing the work of grinding under a combination of the best utilitarian conditions, having regard to both the wheel used and the material to be treated. Pages 17 to 41 tabulate all the grinding jobs likely to be encountered in industry, and indicate suitable abrasive material, size of grit, grade of hardness and process. Its utility to the foundry industry can be gauged by the fact that there are at least 34 major headings devoted to cast products, each one of which will contain several subheadings. Naturally, this splendid table requires intelligent application, as slight modifications in works practice call for adjustments in application. Two tables of grinding speeds—high and low—are set out to show the peripheral speed in feet per minute for diameters ranging from 1 to 36 in. These have also been included, four pages ruled off for recipients to record data found to give maximum satisfaction on their own class of work. The booklet is available to our readers on request.

Pistons.—We have received from Joseph Stubbs, Limited, Ancoats, Manchester, an illustrated booklet describing the Diatherm Piston. This has been invented by Mr. de Fleury, the French metallurgist, who has taken a great part in the development of the aluminium-silicon alloys. The cardinal points for a piston are lightness, mechanical strength at working temperatures, wearing properties, high thermal conductivity and low coefficient of linear expansion. This new alloy has a coefficient of linear expansion of only 0.000018, its thermal conductivity is only 0.42, and its density 2.60 ("Y" alloy is 2.80). Naturally, design is an important factor, and a close study has been made of such factors as temperature gradients. The booklet closes with an offer to submit schemes for the improvement in performance of any engine. The pamphlet is very clearly printed and its message logically stated.

The Corrosion of Light Alloys.

A quantity of research has been published in the last few years in different countries dealing with the corrosion of light alloys of aluminium. By reason of the diversity of methods employed, it is not always possible to correlate the results. It suggested itself as interesting to contribute to a desirable unification by publishing the methods which the laboratories of the different firms who are members of the Aluminium Association—that is to say, in practice the majority of the European producers of aluminium—have just agreed to adopt in common. These methods have been selected by a Commission of the heads of the different research laboratories acting in conjunction with the Bureau International de l'Aluminium, 23, Rue de Balzac, Paris, from whom any further particulars may be obtained on request. The differences between the results obtained by different workers are attributable to a variety of causes, of which the following are chief:—

Difference in Method.—The phenomena giving rise to or furthering the corrosion of alloys are complex, and although a number of them have been probed there are yet others which are unknown quantities. As a result, it is impossible to compare results of investigations which have not been carried out by rigorously analogous methods, since the exact influence of the different factors on the corrosion is too often not estimated.

Difference in Interpretation of Results.—The phenomena of corrosion, no matter in what way they are manifested, cannot be translated into numerical values without previously fixing symbolic values for unity, *e.g.*, the loss of weight expressed in grammes per cubic decimetre of surface per day, the diminution of thickness expressed in millimetres at the end of a given time, etc.

Insufficient Indications regarding the Characteristics of the Alloys.—An alloy is not exactly connotated by its name: frequently in alloys sold under the same name there are considerable differences in composition and the mechanical or thermal treatments undergone by the metal have an important bearing on the results. Consequently, corrosion results relating to alloys of the same name may present considerable deviations according to the test metal used for the experiments. To compare the results of corrosion tests carried out on the same alloy, it is indispensable for the methods used to be the same and for all the factors influencing the tests to be known.

General Considerations.

In order to make possible ultimately a comparison of results it is particularly recommended that at the commencement of the account of any corrosion test, the fullest possible details of the alloys concerned should be given. It is indispensable to indicate: (*a*) The exact analysis of the alloy; (*b*) its state and any treatments it may have received (casting, forging, rolling, extruding, etc. . . . work-hardening or heat-treatment, temperature and duration of such treatments, etc.), and (*c*) state of surface, as cast or machined, or as rolled, cleaned, etc., and in what way. It is of value to indicate likewise the figures obtained from Mylius' Thermic Test and "Activated" Test, if these two tests are carried out. These allow of obtaining very rapidly a check on the temperature of heat-treatment and their values give an immediate idea of the state of the alloy.

Dimensions of Test-pieces.—The exact dimensions of the test-pieces used should always be given accurately. In all cases where the test does not require the use of a special form of test-piece or where the test is not of necessity carried out on a ready-made article or on a test-piece which cannot be modified, it is recommended to adhere to the following dimensions: For test-pieces cut out of sheet metal, 150 × 32 × 1 mm.; and for cast test-pieces, 150 × 27.5 × 5 mm. These dimensions give in either case a total surface of 1 sq. decimetre.

Dimensions of the Containers.—In all cases where a special form of test apparatus is not requisite, beakers (without lip) of the following dimensions should be used: Height, 200 mm.; and internal diameter, 60 mm. These beakers should always be covered. The dimensions stated allow of using a volume of liquid equal to 500 cc. or more when the tests are carried out with test-pieces of the dimensions quoted above, the test-pieces being placed slanting in the beaker at an angle of 20 deg. with the wall.

Temperature of the Tests.—Unless special directions are given, the tests should be carried out at ordinary temperature, that is to say, between 18 and 20 deg. C.

Suspension of Test-plates. — When the test-plates are suspended in corrosive media, it is recommended to pierce two holes, one at the top and one at the bottom of the test-plate, and to invert the plate once a week, so as to distribute as homogeneously as possible the action of the corrosive media.

Cleaning of Test-pieces.—All specimens used for the tests shall be cleaned in one of two ways, depending upon the results desired. (*a*) *Soda Method.* The method described under the thermal hydrochloric acid test shall only be used for this test and for such others where the resistance to corrosion offered by the rolled surface or outer skin is of no importance or is deliberately removed; and (*b*) *Degreasing in Spirit.* Degreasing in petrol followed by absolute alcohol and rinsing in distilled water shall be substituted for the soda treatment in all cases where the resistance of the outer surface is of importance. It is important that the particular method used be mentioned in all test reports.

Rapid Tests.

The memorandum then outlines a series of accelerated tests such as the Thermic test with hydrochloric acid ascribed to Mylius; the gas volume test with hydrochloric acid and the activated corrosion test also due to Mylius.

Proper Corrosion Tests.

Modified Mylius' Test.—The test is carried out in large glass troughs of internal diameter 215 mm. and the internal height 320 mm. They contain 9 to 10 litres of liquid. These troughs are placed in a water-bath which during the test is kept at 20 deg. (± 1 deg.). Inside the trough is placed a support formed of two glass rings mounted on three legs, on which the test-plates are hooked. A stirrer whose stem passes through the cover of the trough ensures continuous movement of the liquid. The number of test-plates taken for the test is at the most 10. They should have the dimensions indicated above, the distance between the two circles being calculated accordingly. The test-plates have two holes pierced in them, one at the top and one at the bottom, by which they are hooked to the circles. The attacking solution consists of a N/2 solution of NaCl (about 3 per cent.) containing 0.1 per cent. of a pure hydrogen peroxide. The H_2O_2 percentage is verified daily by titration and readjusted exactly by means of a solution of 30 per cent. H_2O_2 (titration against permanganate of potash). The agitator is revolved at 135 r.p.m. At fixed intervals (at the end of every 15 days, 1, 2 or 3 months, for example) the test-plates are withdrawn and submitted to a tensile test. The diminution in the breaking load or elongation is noted, compared with a test-plate of the same metal not corroded.

Solubility Test in Ordinary Corrosive Media.—Regarding the dimensions of the test-plates and of the beaker and the temperature of testing, the details given above should be referred to. The test-plates may be used either with rough manufactured surface or machined; in all cases exact data on the state of the surface should be noted in the description of the test. The test-plates should be carefully degreased before the test. The volume of corrosive fluid should be 500 cc. and the degree of purity and the concentration of the liquid should be accurately stated. The beakers should be kept continually covered (with a watch-glass or glass plate). The duration of the test should be noted with exactitude and likewise the periods between weighing the test-plates. It should be stated whether or not the liquid is renewed during the test. The loss of weight resulting in a unit of time (hour, day, week or month) should be expressed in grammes per square decimetre of surface.

Salt Spray Test.—For dimensions of test-plates use the standard indicated above.

The apparatus used consists of a cubic glass trough with framework of stainless steel or wood and movable cover. In the bottom is placed a glass atomiser which is operated by compressed air. By means of this atomiser a 3 per cent. solution of salt water, contained in the trough to a depth of about 5 cm., is reduced to a fine spray The temperature should, if possible, be kept between 15 and 20 deg. To avoid any spurting on to the test-plates a glass plate is supported by a framework between the atomiser and the test-plates. The drops of water are thus condensed on to the plate, and the test-plates, which are suspended by means of small glass rings and a thread, are thus solely in contact with a saline vapour.

Results.—The diminution in the breaking load and in the elongation is expressed as a function of time (periods of 15 days, 1 month, 3 months, 6 months, for example). Before carrying out the tensile testing and in order to reduce the influence of the commencement of rupture due to corrosion at the edges of the test-plate, the usual tensile test-pieces are cut from the metal which has been used for the test. The width cut of the corrosion test-plates should be not less than 5 mm. at each edge, either for cast or cut test-plates. The section of the tensile test-piece should be calculated from the thickness of the plate before corrosion and the actual width.

It is advisable not to test together alloys of different types, so as to avoid possible action of the products formed by corrosion. Where it is possible to arrange by some means a continuous circulation of the corrosive liquid, it is unnecessary to have a special apparatus. Such an apparatus should do for atomising any spray. It is wise to have a sheet of pure aluminium in the bottom of the trough, upon which the heavy metals (copper, for example) resulting from the corrosion of the different alloy test-plates may be attracted. By this means the solution is purified.

Immersion Test.—Systematic immersion tests in different liquids may be carried out, either in beakers of the dimensions stated above, or in large glass troughs in which the test-plates may be suspended in the same way as in the salt-spray test. An alternative method which would give results would be to use a trough in which an agitator is fixed up or a glass tube allowing of air or gas being injected. In any case, in the description of the test full details should be given of the *modus operandi*.

For the systematic tests the following media are used:—Distilled water; spring water of different hardness; 3 per cent. NaCl solution; artificial sea water; spring water containing acids, alkalis or different salts of heavy metals in very small amount; and saline solutions.

All these liquids are used (1) without agitation of the solution, (2) with injection of air and (3) with injection of CO_2.

To prepare the saline solutions it is important to use only distilled water or water carefully freed from salts, for if hard water is used the test-plates are rapidly covered with a calcareous

(*Concluded on page* 326.)

This Week's News in Brief.

Trade Talk.

THE DAFEN SHEET WORKS, Llanelly, were re-opened recently after a 10-months' stoppage.

MR. WARWICK BROOKES, late of 5, Suffolk Street, Pall Mall, London, S.W.1, ironfounder, has been adjudged bankrupt.

FIVE SHEET MILLS, which were closed for over a year, have been reopened by Messrs. W. Gilbertson & Company, Limited, of Pontardawe.

MESSRS. W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED, have opened new branch stores at Park House, Friar Lane, Nottingham, and Victoria Mill, Trafalgar Street, Burnley.

INDIAN PIG-IRON is being sold in Japan at an import price, including freight, of less than 30 rupees (£2 5s.), as against 65 rupees (£4 17s. 6d.), the rate at which it is quoted in India.

MESSRS. LITHGOWS, LIMITED, Port Glasgow, have secured a contract for the re-conditioning of a Blue Star Line vessel, and it is anticipated that a similar contract will be secured in the course of the next week or two.

ONLY ONE VESSEL was launched on the Tyne during October This brings the total for the first ten months of the year up to 18 ships, against 57 vessels for the corresponding period of last year, representing a decrease of 179,858 gross tons.

THE NORTH EASTERN MARINE ENGINEERING COMPANY, LIMITED, Sunderland, has booked a contract for the supply of the machinery for a vessel being built by the Burntisland Shipbuilding Company, Limited, for a North-East Coast firm of shipowners.

THE BRITISH STEELWORK ASSOCIATION announces that the contract for the steelwork for the Glyn Mills Bank in Lombard Street, London, E.C., has been placed with Messrs. Redpath, Brown & Company, Limited. The amount of steelwork involved is 2,000 tons.

THE LANARKSHIRE STEELWORKS are experiencing a welcome improvement in export trade, and considerable orders have been booked for Canada and Australia. The Dominion Bridge Company has ordered a large quantity of plates from one of the Lanarkshire companies.

THE FIRST LAUNCH on the Wear for some months took place last week from the yard of Messrs. Swan, Hunter & Wigham Richardson, Limited, who launched the collier " Flinthouse " for Messrs. Stephenson, Clarke & Associated Companies, Limited, of London and Newcastle.

WITH REGARD to the amalgamation scheme between the North Lonsdale Iron & Steel Company, Limited, and the Millom & Askam Hematite Iron Company, Limited, it is announced that acceptances have been received from holders of more than the stipulated 75 per cent. of the shares.

OUT OF THE £1,500,000 debenture issue by the South African Iron & Steel Industrial Corporation, Limited, the public applied for only just over £100,000, states a message from Johannesburg. The Public Debt Commissioners took £1,000,000 and the Electricity Supply Commission £100,000.

IN HIS PRESIDENTIAL ADDRESS to the Cleveland Institution of Engineers, at Middlesbrough, Mr. R. E. Cowell said that whatever was wanted in steel the works in Middlesbrough would produce it. This elasticity to deliver against almost any specification was one of the greatest assets they had in that district.

ALLDAYS & ONIONS, LIMITED, Great Western Works, Small Heath, Birmingham, have secured an order for the smithy equipment at the new smiths' shop for the Southern Railway at Southampton. This includes three N.G.K. compound pneumatic hammers, together with a motor-driven air compressor and accessories, smiths' hearths and motor-driven fans.

MESSRS. FREDK. BRABY & COMPANY, LIMITED, have recently secured the sole rights of a new invention in metal-covered plywood, and have just equipped a special factory with the necessary machinery at their Eclipse Steelworks, Glasgow, for a large output of this product. This invention consists of thin sheets of plywood to which galvanised sheet steel or other sheet metal is cemented by hydraulic pressure on one or both sides. The cementing composition, it is stated, is of such a nature that neither moisture, heat, water nor force can separate the metal from the plywood, and the finished panel is dead flat and smooth. In addition to galvanised steel-sheet covering, the plywood can also be supplied covered with stainless steel, bronze, copper, zinc or aluminium. Its trade mark is to be " Eclipse."

THE BUSINESS FORECAST issued quarterly by the Federation of British Industries states that the suspension of the gold standard by Great Britain on September 21 marked the close of an era of contraction both in British industry at home and in the markets dependent on British finance overseas, which, ever since the re-adoption of that standard in 1925, has made the task of carrying on British trade progressively less tolerable. For this reason alone it is justifiable to conclude that at no time since the collapse of the United States Stock Exchange boom in October, 1929, has the outlook for British trade been more hopeful than it is at present. Unfortunately this optimism is tempered by many adverse international circumstances. The world crisis is not yet over. The creeping paralysis of financial stringency, so far from relaxing its hold on our principal overseas markets, continues to spread; while the gold rush in the countries still adhering to the gold standard is perpetuating the deflationary influences which have been driving down world prices. It is added that the outlook in Europe must continue to be permeated with grave anxiety so long as the German reparation and commercial debt questions remain unsettled.

Contracts Open.

Angora, December 23.—Refractory bricks, for the Ministry of National Defence. The Department of Overseas Trade. (Reference B.X. 7,188.)

Bridlington, November 23.—Supply and laying of water mains, for the Town Council. The Waterworks Engineer, Marton Road, Bridlington. (Fee £5 5s., returnable.)

Exmouth, November 23.—Cast-iron mains, hydrants and valves, etc., for the Exmouth Urban District Council. Mr. S. Hutton, Council Offices, Exmouth.

Inverness.—Supplying and fixing of cast-iron pipes, 2-ft. 6-in. and 2-ft. dia., for the Town Council. Mr. A. F. Mackenzie, borough surveyor.

Johannesburg, December 30.—Steam turbine and centrifugal pump, with condenser and accessories, for the Rand Water Board. The Department of Overseas Trade. (Reference G.X. 10,908.)

Llandrindod Wells, December 1.—1,000 yds. of 8-in. cast-iron pipe rising main, for the Urban District Council. Messrs. Fiddian & Deeley, 13, Church Street, Stourbridge. (Fee £2, returnable.)

Porthcawl, November 21.—Provision and laying of 1,200 yds. of 10-in. dia. cast-iron mains, etc., for the Urban District Council. The Council Offices, Porthcawl. (Fee £5, returnable.)

Company Meeting.

Samuel Osborn & Company, Limited.—The annual meeting of Messrs. Samuel Osborn & Company, Limited, was held at the Clyde Steelworks, Sheffield. MR. W. F. OSBORN (chairman) said that it was impossible to recommend the payment of a dividend on the ordinary shares. Instead of industry getting the help and encouragement it so badly needed, the burdens had been increased by additional taxation. Although this might have been necessary in order to balance the Budget, it helped to increase costs at a time when it was most necessary to reduce them in order to compete more successfully with other countries. The balance sheet was a very strong one, and the financial position was thoroughly sound.

Ropes can be protected against hydrochloric acid fumes by impregnating them with tar or bitumen.

Personal.

MR. W. G. GRAY, general manager of the Steel Company of Scotland, Limited, has been elected a trustee of the Clyde Navigation Trust.

MR. WILLIAM REAVELL, of Messrs. Reavell & Company, Limited, Ipswich, has been re-elected President of the British Engineers' Association.

MR. JAMES MUIR, a steel dresser in the Hallside Foundry of the Steel Company of Scotland, Limited, Newton, celebrated his golden wedding on November 11.

MR. JAMES SMITH, instructor for many years of Colvilles Dalzell Works Ambulance Section, was presented on his retirement with a radio set from members of the class.

MAJOR D. J. COLVILLE, M.P., a director of Messrs. Colvilles, Limited, and Messrs. Smith & McLean, Limited, has been appointed Secretary to the Department of Overseas Trade.

MR. ROBERT BLAIR, an assistant chemist with the North British Steel Foundry Company, Limited, Bathgate, and a student at Bathgate Academy, has been awarded the Worshipful Company of Ironmongers' prize and bronze medal.

A LARGE COMPANY gathered in the works canteen of John G. Stein & Company, Limited, Castlecary, recently, to present to Mr. T. Buchanan, a member of the staff, a clock as a token of esteem from the firm and fellow employees on the occasion of his marriage.

AT THE 10th annual meeting of the British Cast Iron Research Association, held at the Institute of Mechanical Engineers, Sir Harold Hartley, F.R.S., vice-president of the London Midland & Scottish Railway Company, and in charge of research, was unanimously re-elected President for the ensuing year.

PROF. JOHN HAROLD ANDREW, who has occupied the chair of metallurgy at the Royal Technical College, Glasgow, for the past eleven years, has been appointed Professor of Metallurgy in the University of Sheffield, in succession to Prof. Desch, who was recently appointed to the National Physical Laboratory.

SIR HOLBERRY MENSFORTH has joined the boards of Messrs. John Brown & Company, Sheffield and Clydebank, and of Messrs. Thos. Firth & John Brown, Limited, Sheffield. Sir Holberry is a Vice-President of the British Electrical and Allied Manufacturers' Association, chairman of the English Electric Company, Limited, and a director of the Darlington Rolling Mills Company, Limited, and Messrs. Dorman, Long & Company, Limited.

Wills.

FIRTH, J. C. B., a director of Messrs. Thomas Firth & John Brown, Limited, Sheffield £14,706

BANKS, FREDERICK, of London, representative of Messrs. Sanderson Bros. & Newbould, Limited, Sheffield £10,668

WILLIAMS, DAVID, a director of the Alyn Steel Tinplate Company, Limited, Mold £12,119

STANTON, SIR THOMAS E., F.R.S., formerly superintendent of the Engineering Department of the National Physical Laboratory £14,998

Obituary.

MR. ROBERT MICHAEL DONALDSON, late chairman and managing director of James Dunlop & Company, Limited, Glasgow, died at Ospedaletti, Italy, on November 4.

MR. THOMAS LAWRENCE BEARE, senior partner in the firm of Henry Beare & Sons, Limited, engineers and founders, Newton Abbot, died on Wednesday, November 4, at the age of 71.

THE DEATH occurred on November 9 of Mr. William Wilson Robertson, who was well known in engineering and locomotive building circles. He served his apprenticeship with the old Caledonian Railway Company, at St. Rollox, Glasgow, and was inspector for the South Indian Railway for over 40 years.

Raw Material Markets.

The iron and steel markets during the past week have been quieter but steady, and new business has been on a small scale, as most of the large consumers have already arranged contracts to the end of the year, if not further. There has been more activity at the consuming end, and better deliveries against contract are being requisitioned—always a welcome sign. The heavy engineering section is still in an unsatisfactory condition, and recent improvements in consuming industries seem to be mainly confined to the light-castings foundries.

Pig-Iron.

MIDDLESBROUGH.—Although most of the big consumers in this district are covered to the end of the year, there is a steady demand for small lots, and last week's turnover was quite satisfactory. From the producers' point of view present prices are unremunerative, but at present no increases are meditated, as the ironmasters would prefer to get more of their idle plant into operation. Deliveries against current contracts are being readily taken, and many producers state that they have succeeded in liquidating their stocks, which were such a burden some months ago. Export business is not so satisfactory, and comparatively few transactions have been recorded. Prices remain unaltered:—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

There has been an improvement in the East Coast hematite market, and more contracts have been negotiated with steelmakers in the Midlands. Makers are disposed to ask a premium for supplies for the first quarter of 1932. Some sales have already been concluded. The current price for mixed numbers is 65s., with 6d. extra for No. 1 quality, more being asked in some cases.

LANCASHIRE.—There has been no improvement in the demand in this area, but future prospects are brighter, as consumers in this district are now in a better position, and scrap iron and steel has also risen in price, supplies being sparingly released at current rates. For delivery in the Manchester price zone, Staffordshire, Derbyshire and North-East Coast brands of No. 3 iron are quoted at 67s. per ton, with Northamptonshire foundry iron at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at 86s. 6d. to 87s. and West Coast hematite iron at about 81s. per ton.

MIDLANDS.—There is little new business available at present, and the best feature of the market is the steady call for deliveries into consumption—a welcome sign that the foundries are in a better position. The heavy engineering section, however, is still under a cloud. For delivery to Birmingham and Black Country stations, producers continue to quote 62s. 6d for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Business in the pig-iron market has slackened slightly, but the consumption of the foundries remains steady. Scottish No. 3 foundry iron remains at 69s. 6d. f.o.t. furnaces, but Cleveland No. 3 has been sold at 61s. 6d. at Grangemouth. Dutch pig-iron continues to arrive in large quantities, but would seem to be uncompetitive at the prices now quoted.

Coke.

In the Midlands district prices of foundry coke are well maintained, although there has not been any noticeable increase in sales. There is a better demand for furnace coke, and prices show an upward tendency. Prices (f.o.t. Birmingham) are:—Best Welsh foundry, 34s. to 39s. 6d.; second quality, 29s. to 33s.; best Durham, 34s. to 37s. 6d; furnace coke, 20s. to 22s. 6d.

Steel.

Present conditions in the finished steel trade leave much room for improvement. Although the future is more promising, orders are at the moment difficult to obtain, and few mills are able to work full-time. There seems to be little demand from the heavy industries, although the consumption of small steel bars and black sheets is somewhat better. There is also a better demand in the semis market, and the British works are in an improved position. Prices of semi-finished steel have risen.

Scrap.

In the Cleveland scrap iron and steel market, there is a much improved demand. The minimum price for heavy steel is now 40s. per ton, while 35s. has been paid for light cast-iron. The recent improvement in the Midland area is strongly maintained. Heavy steel scrap is at 35s. per ton delivered, while light cast iron remains at 40s. The South Wales market is also showing signs of improvement. Slightly more business is being done in Scotland, but the turnover remains small, as the position of the large consumers is not much improved.

Metals.

Copper.—The London copper market has fluctuated in accordance with the rumours which are coming through as to the progress of the New York conference, about which no authoritative statement has, as yet, been issued. Hence speculative interests have played a large part in the recent fluctuations of price. There has, however, been a better demand for consumption, and more business has come into the hands of the exporters, whose price remains at 7.50 cents c.i.f. Europe.

Closing quotations :—

Cash.—Thursday, £37 3s. 9d. to £37 5s.; Friday, £37 7s. 6d. to £37 10s.; Monday, £38 6s. 3d. to £38 7s. 6d.; Tuesday, £37 12s. 6d. to £37 15s.; Wednesday, £35 12s. 6d. to £35 15s.

Three Months.—Thursday, £37 16s. 3d. to £37 17s. 6d.; Friday, £38 to £38 2s. 6d.; Monday, £38 17s. 6d. to £38 18s. 9d.; Tuesday, £38 5s. to £38 17s. 6d.; Wednesday, £36 2s. 6d. to £36 5s.

Tin.—The price of tin continues to be fairly steady. There seems to be no increase in consumptive buying, and no revival seems possible until there is a return to normal activity in the consuming trades. In connection with the latter, it is interesting to note the progress of the British canning industry, one of our newest and most successful trades. It is hoped that further work will be found for the tinplate mills.

Official closing prices :—

Cash.—Thursday, £132 15s. to £132 17s. 6d.; Friday, £133 to £133 5s.; Monday, £134 2s. 6d. to £134 5s.; Tuesday, £134 5s. to £134 10s.; Wednesday, £131 17s. 6d. to £132.

Three Months. — Thursday, £134 15s. to £134 17s. 6d.; Friday, £135 2s. 6d. to £135 5s.; Monday, £136 2s. 6d. to £136 7s. 6d.; Tuesday, £136 5s. to £136 7s. 6d.; Wednesday, £133 17s. 6d. to £134.

Spelter.—There is a better feeling in this market, and the demand is fairly good. The situation depends upon the position of the consuming trades. Unfortunately the galvanising trades are at present experiencing a quiet time.

Daily fluctuations :—

Ordinary. — Thursday, £13 15s.; Friday, £14 1s. 3d.; Monday, £14; Tuesday, £14 3s. 9d.; Wednesday, £14.

Lead.—There has been an improved demand for this metal, and the position is satisfactory. Consumers are in a better position, there being numerous inquiries for manufactured goods for export.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £14 12s. 6d.; Friday, £14 18s. 9d.; Monday, £15 1s. 3d.; Tuesday, £14 16s. 3d.; Wednesday, £14 12s. 6d.

Wood packing must be used to protect chains from sharp-edged work.

Reports and Dividends.

Guest, Keen & Nettlefolds, Limited.—Interim dividend for the six months ended September 30 at the rate of 5 per cent. per annum, free of tax, on the first preference shares.

Birmingham Aluminium Casting (1903) Company, Limited.—Profit, £15,488; brought in, £24,394; preference dividend, £160; ordinary dividend of 5 per cent., £10,198; depreciation reserve, £5,000; carried forward, £24,524.

John I. Thornycroft & Company, Limited.—Profit, £21,344; brought in, £59,258; carried forward, after payment of debenture interest and dividend on the 6 per cent. preference share capital, £52,108. No dividend is to be paid on the preferred or ordinary shares.

Renold & Coventry Chain Company, Limited.—The first report shows that, after deducting income tax, the dividends declared by the subsidiaries from the merger date (September 1, 1929) to July 4, 1931, totalled £114,018. A substantial proportion (£32,992) was paid to the shareholders in the constituent companies before they transferred their shares to this company. The balance has been brought into the profit and loss account of this company—namely, £81,054. A final dividend of 2½ per cent. (actual) on the ordinary shares is proposed, leaving a credit balance of £16,789.

The Public Works, Roads and Transport Exhibition.

This exhibition, which opened last Monday and closes next Saturday, is being held at the Agricultural Hall, London, N. It is stated that a quarter of a million tons of machinery has been gathered together, so an estimate of 100,000 tons of castings makes it an attractive foundry exhibition. The exhibits which interested us the most were Iron Roads, Limited (on the Stand of J. B. Corrie, Limited), and a mechanical shovel on the Stand of Thomas Coleman & Sons, Limited, of Derby. The former exhibit incorporates triangular castings, webbed, and, obviously, giving a 3-point suspension. They will weigh about 10 lbs. each. There is a stretch laid outside the Hall, which was much drier than the wood blocks, and skidding seemed impossible. We envisage a great field for their application by replacing granite setts. Naturally, they will have to be manufactured under the very latest mass-production methods to work down to a competitive price.

The Coleman mechanical shovel makes 64 movements a minute, so if it picks up 8 lbs. of sand it would shift nearly 5 cwts. in that time, or 15 tons an hr. Actually the makers claim 30. As the shovel is certainly larger than an ordinary manual one, it may be no exaggeration. Its throw can be regulated to a maximum of 10 ft.

The Dover Engineering Company were exhibiting their man-hole covers, to which we can pay no higher compliment than to say that at last this simple job has been made a credit to both engineer and foundry.

The Corrosion of Light Alloys.

(*Concluded from page* 324.)

film which protects it against possible corrosion by the medium concerned. The loss in weight per sq. decimetre is noted as a function of time.

Alternate Immersion Test.—Test-plates of the indicated dimensions are suspended by means of glass rings and alternately immersed in and withdrawn from a corrosive liquid by means of a time-controlled mechanism. The loss in weight per sq. decimetre of surface is noted as a function of time. As an alternative the diminution of the breaking load and of the elongation as a function of time may be noted in both the immersion and alternate immersion test methods.

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WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	35 12 6
Three months	36 2 6
Electrolytic	41 0 0
Tough	37 0 0
Best selected	37 5 0
Sheets	70 0 0
India	48 15 0
Wire bars	44 10 0
Do., December	44 10 0
Do., January	44 10 0
Ingot bars	44 10 0
H.C. wire rods	46 0 0
Off. av. cash, Oct.	35 0 1 1/21
Do., 3 mths., Oct.	35 16 10 23/42
Do., Sttlmnt., Oct.	34 19 10 5/11
Do., Electro, Oct.	41 8 10 5/11
Do., B.S., Oct.	37 19 2
Do., wire bars, Oct.	41 17 8 5/11
Solid drawn tubes	10½d.
Brazed tubes	10½d.
Wire	7½d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8d.
Wire	8½d.
Rolled metal	7½d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6d.

TIN.

	£ s. d.
Standard cash	131 17 6
Three months	133 17 6
English	133 5 0
Bars	135 5 0
Straits	134 10 0
Australian	133 0 0
Eastern	136 15 0
Banca (nom.)	148 5 0
Off. av. cash, Oct.	127 0 9 6/11
Do., 3 mths., Oct.	129 16 7 1/11
Do., Sttlmt., Oct.	127 0 2 5/11

SPELTER.

	£ s. d.
Ordinary	14 0 0
Remelted	12 15 0
Hard	10 15 0
Electro 99.9	16 7 6
English	15 0 0
India	12 15 0
Zinc dust	23 0 0
Zinc ashes	3 15 0
Off. aver., Oct.	12 19 5 13/42
Aver. spot, Oct.	12 14 7 10/11

LEAD.

	£ s. d.
Soft foreign ppt.	14 12 6
English	16 5 0
Off. average, Oct.	13 4 11 23/42
Average spot, Oct.	13 4 6 6/11

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	24 0 0
Do., V.M. ex-whf.	24 10 0
Rods	30 0 0
Boiler plates	—
Battery plates	—

ANTIMONY.

	£ s. d.
Special brand, Eng.	40 0 0
Chinese	30 0 0
Crude	22 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	16 17 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 0 0
45/50%	£10 0 0
75%	£15 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free nom.	4/2 lb. Mo. plus 35%
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£16 0 0
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£34 0 0
4/6% car.	£24 0 0
6/8% car.	£22 17 6
8/10% car.	£22 0 0
Ferro-chrome—	
Max. 2% car.	£35 0 0
Max. 1% car.	£40 0 0
Max. 0.70% car.	£51 0 0
70% carbon-free	11d. lb.
Nickel—99%	£220 to £225
Ferro-cobalt	8/6 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	2 6 0 to	2 7 6
Bundled steel and shrngs.	1 17 6 to	2 6 0
Mixed iron and steel	2 0 0 to	2 3 6
Heavy cast iron	2 7 0 to	2 8 0
Good machinery for foundries	2 10 0	
Cleveland—		
Heavy steel	2 0 0	
Steel turnings	1 10 0	
Cast-iron borings	1 4 0	
Heavy forge	2 17 6	
W.I. piling scrap	2 15 0	
Cast-iron scrap	2 5 6 to	2 7 6
Midlands—		
Light cast-iron scrap	2 0 0	
Heavy wrought	2 10 0	
Steel turnings, f.o.r.	1 0 0	
Scotland—		
Heavy steel	2 0 0	
Ordinary cast iron	2 7 6	
Engineers' turnings	1 9 6	
Cast-iron borings	1 10 0	
Wrought-iron piling	2 7 0	
Heavy machinery	2 12 6	

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	30 0 0
Brass	21 0 0
Lead (less usual draft)	12 10 0
Tea lead	9 10 0
Zinc	7 0 0
New aluminium cuttings	62 0 0
Braziery copper	28 0 0
Gunmetal	25 0 0
Hollow pewter	85 0 0
Shaped black pewter	65 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/6
Hematite M/Nos.	65/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
,, No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—
*d/d Black Country dist.	
Scotland—	
Foundry No. 1	72/-
,, No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	77/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	86/6 to 87/-
Clyde, No. 3	86/6 to 87/-
Monkland, No. 3	86/6 to 87/-
Summerlee, No. 3	86/6 to 87/-
Eglinton, No. 3	86/6 to 87/-
Gartsherrie, No. 3	86/6 to 87/-
Shotts, No. 3	86/6 to 87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 15 0 to	10 5 0
Nut and bolt iron	8 7 6 to	8 12 6
Hoops	10 10 0 to	12 0 0
Marked bars (Staffs) f.o.t.	12 0 0	
Gas strip	10 10 0 to	12 0 0
Bolts and nuts, ¾ in. × 4 in.	—	
Steel—		
Plates, ship, etc.	8 15 0 to	8 17 6
Boiler plts.	8 15 0 to	9 15 0
Chequer plts.	10 7 6	
Angles	8 7 6	
Tees	9 7 6	
Joists	8 15 0	
Rounds and squares, 3 in. to 5½ in.	9 7 6	
Rounds under 3 in. to ¾ in. (Untested)	6 17 6 & up.	
Flats—8 in. wide and over	8 12 6	
,, under 8 in. and over 5 in.	8 17 6	
Rails, heavy	8 5 0 to	8 10 0
Fishplates	12 0 0	
Hoops (Staffs)	9 10 0	
Black sheets, 24g.	8 5 0 to	9 5 0
Galv. cor. shts.	9 5 0 to	9 10 0
Galv. flat sheets	9 15 0 to	10 0 0
Galv. fencing wire, 8g. plain	—	
Billets, soft	5 7 6 to	5 12 6
Billets, hard	6 12 6	
Sheet bars	5 0 0 to	5 10 0
Tin bars	5 0 0	

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12½d.
Rods	11½d.
Tubes	16½d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
5% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1¼ to 1/7¼
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.76
No. 2 foundry, Valley	16.00
No. 2 foundry, Birm.	12.00
Basic	16.76
Bessemer	18.26
Malleable	18.26
Grey forge	17.76
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
,, furnace	16/- to 17/-
Durham and Northumberland—	
,, foundry	15/- to 15/6
,, furnace	15/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	13/9 to 14/3
,,	28×20 ,,	27/6 to 28/-
,,	20×10 ,,	20/3
,,	18¾×14 ,,	14/9
C.W.	20×14 ,,	12/9 to 13/-
,,	28×20 ,,	25/9
,,	20×10 ,,	19/6
,,	18¾×14 ,,	14/- to 14/3

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

			£	s.	d.		
Nov.	12	..	37	3	9	inc.	6/3
,,	13	..	37	7	6	,,	3/9
,,	16	..	38	6	3	,,	18/9
,,	17	..	37	12	6	dec.	13/9
,,	18	..	35	12	6	,,	40/-

Electrolytic Copper.

			£	s.	d.		
Nov.	12	..	41	10	0	No change	
,,	13	..	43	0	0	inc.	30/-
,,	16	..	43	0	0	No change	
,,	17	..	43	0	0	,,	,,
,,	18	..	41	0	0	dec.	40/-

Standard Tin (cash).

			£	s.	d.		
Nov.	12	..	132	15	0	inc.	15/-
,,	13	..	133	0	0	,,	5/-
,,	16	..	134	2	6	,,	22/6
,,	17	..	134	5	0	,,	2/6
,,	18	..	131	17	6	dec.	47/6

Tin (English ingots).

			£	s.	d.		
Nov.	12	..	134	5	0	inc.	15/-
,,	13	..	134	10	0	,,	5/-
,,	16	..	135	15	0	,,	25/-
,,	17	..	135	15	0	No change	
,,	18	..	133	5	0	dec.	50/-

Zinc Sheets (English).

			£	s.	d.		
Nov.	12	..	24	0	0	No change	
,,	13	..	24	0	0	,,	,,
,,	16	..	24	0	0	,,	,,
,,	17	..	24	0	0	,,	,,
,,	18	..	24	0	0	,,	,,

Spelter (ordinary).

			£	s.	d.		
Nov.	12	..	13	15	0	dec.	1/3
,,	13	..	14	1	3	inc.	6/3
,,	16	..	14	0	0	dec.	1/3
,,	17	..	14	3	9	inc.	3/9
,,	18	..	14	0	0	,,	3/9

Lead (English).

			£	s.	d.		
Nov.	12	..	16	5	0	dec.	5/-
,,	13	..	16	10	0	inc.	5/-
,,	16	..	16	10	0	No change	
,,	17	..	16	5	0	dec.	5/-
,,	18	..	16	5	0	No change	

Imports and Exports of Iron Castings in October and the ten months 1931, compared with October and the ten months 1930.

	October, 1930.	October, 1931.	Ten months, 1930.	Ten months, 1931.	October, 1930.	October, 1931.	Ten months, 1930.	Ten months, 1931.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	2,259	995	17,645	11,260	23,798	13,899	208,930	146,428
Castings, in the Rough, Iron	293	15	2,050	1,179	6,188	328	43,873	23,766
,, ,, ,, Steel	735	655	11,321	5,262	19,130	10,665	270,799	108,274
Hollow-ware, Cast, not Enamelled	9	3	35	67	776	246	3,543	4,681
,, ,, Enamelled	12	2	30	48	647	152	1,758	2,641
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	109	25	1,632	711	5,027	771	73,308	33,184
,, British South Africa	354	157	2,105	1,839	13,245	6,006	81,716	68,243
,, ,, India	156	71	1,299	1,107	5,135	2,697	47,273	40,283
,, Australia	9	—	252	67	368	26	14,498	3,332
,, New Zealand	67	21	830	306	3,608	993	48,471	18,973
Total (including other countries)	1,782	1,212	14,788	11,232	77,083	55,778	656,117	497,977
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,533	314	13,363	4,693	15,088	2,934	132,288	45,258
,, British South Africa	1,564	464	8,588	6,548	17,166	4,089	91,466	75,261
,, ,, India	234	81	2,520	1,482	2,509	1,216	38,132	24,074
,, Straits Settlements and Malay States	1,375	163	9,320	2,392	13,533	1,379	81,436	25,530
,, Ceylon	115	84	1,318	587	1,718	885	13,913	7,286
,, Australia	12	27	633	146	268	642	11,754	3,293
Total (including other countries)	11,095	5,104	101,140	59,442	123,616	55,868	1,117,767	674,584
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	376	154	3,399	1,798	12,199	6,056	111,588	63,351
,, Enamelled	89	46	700	447	7,191	4,340	59,935	43,637
CASTINGS, in the rough—								
Iron	95	160	1,895	2,036	3,402	7,397	59,761	49,503
Steel	144	69	1,751	1,020	7,513	2,753	72,693	36,458

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

ANALYTICAL Chemist requires position; 13 years' experience home and abroad; pig-iron, steel, coal and by-products, iron and manganese ore; excellent references.—Box 946, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MOULDER, age 25, single, seeks job, anywhere; good jobber, all classes of work. Highest references.—Box 938, Offices of THE FOUNDRY TRADE JOURNAL, 49 Wellington Street, Strand, London, W.C.2.

NON-FERROUS FOUNDRY MANAGER, with first-class references, open to re-engagement; exceptional experience, bench, floor, machine moulding, etc.; best results at lowest possible costs.—Box 940, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

OPENING for young, practical Working Moulder, age 25 to 30, with modern ideas, to train up for executive position in light-casting foundry.—Box 932, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

QUALCAST LTD., DERBY, Repetition Ironfounders to the Automobile Trade, and largest producers of lawn mowers outside U.S.A., require WORKS MANAGER of proved ability. This is an excellent opportunity for the right man, as he will be in charge of the most up-to-date plant in Europe.—Send fullest details to "A. M. D.," Qualcast Ltd., Derby.

WANTED, Grey-Iron Foundry Foreman; must be thoroughly experienced in light-casting trade, loose plate and machine moulding. State categorically full experience, age, salary required, and if engaged.—Box 984, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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Any Member, Associate Member or Associate of the Institute of British Foundrymen who desires his qualifications to be inserted in the column must forward to the General Secretary of the Institute the following information:—(a) Name and address; (b) name of present employer (or last employer if unemployed); (c) brief particulars of qualifications, experience, and type of position required. The name will not be disclosed until the candidate is in communication with a prospective employer. Announcements will be inserted in two successive issues, unless announcers' requirements have been met with in the meantime.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

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Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester.

FOREMAN Coremaker desires change; 12½ years present situation. Thoroughly experienced in oil, dry, and green-sand core-making, and fixing of piece prices. (152.)

SITUATIONS VACANT AND WANTED—*Contd.*

ENGINEER Foundryman seeks responsible post; 6 years foundry manager; specialist in machine moulding for high production and cupola practice. Hons. B.Sc., Mech. Eng. D.O. and machine-shop experience. (151.)

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MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

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with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

MANUFACTURING PREMISES FOR SALE.

BRITISH GRIFFIN CHILLED IRON & STEEL COMPANY, LIMITED.

THE Receiver and Manager is instructed to offer for Sale the Land and Buildings of the above Company, situated in Ainslie Street, Barrow-in-Furness. The Property, which is situated on approximately 7 acres of freehold land, consists of buildings suitable for a Foundry or an Engineering Shop, private railway sidings, and Manager's Residence.

Full details will be supplied on application to H. SYDNEY LORD, Receiver and Manager, 125, Ramsden Square, Barrow-in-Furness.

BRISTOL.

TO Engineers, Founders, Manufacturers.—Fine site of nearly three acres on arterial road, with Foundry and Workshops and own Rail Sidings into the premises. Modern Offices, Warehouses and Workrooms. Central Heating.—CHARLES A. TRICKS & SON, Auctioneers, St. Nicholas Street, Bristol.

FOR Sale, modern London Ironfoundry with railway-siding facilities, on acre of land. Electric power and small machine shop suitable for castings up to 3 tons in weight, capacity 20 tons per week. Overhead crane and all equipment.—Box 936, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

WANTED, Furnace, Morgan Type "S" 600 lbs., coke-fired. Must be in good condition. State price and where to be seen.—Write or 'phone, MORRIS-SINGER COMPANY, 123, Dorset Road, South Lambeth. 'Phone No.: Reliance 2821.

THOS. W. WARD, LTD.

New Wire-Feed Capstans; admit bars 2⅜ in. and 1⅛ in. dia. At bargain prices. Ask for list.

Several Vertical Milling Machines.

6-ft. ASQUITH Central-thrust Girder Radial Drill.

24-in. x 15-in. STONE BREAKER (Goodwin Barsby), flywheels and pulley.

Four LANCASHIRE BOILERS, 30 ft. 0 in. x 8 ft. 0 in., re-insure 200 lbs. pressure.

(ASK FOR "ALBION" MACHINERY CATALOGUE.)

ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued.*

SAND MIXERS.—New and Secondhand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Station Works, Ecclesfield, Sheffield.

'Phone **98** Staines.

NEW Keith Blackman BLOWING FAN. 16-in. delivery, C.I. casing, with extended bed to carry motor; rustless blades; £20 f.o.r. Marshall Hopwood BOILER, 9 ft. x 4 ft., 100 lbs. w.p.

HARRY H. GARDAM & COMPANY, LIMITED, STAINES.

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RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. A new edition will be published next January. Secure your advertising space now. Rates on application.—INDUSTRIAL NEWSPAPERS, LTD., 49, Wellington Street, Strand, London, W.C.2. Telephone: Temple Bar 3951 (5 lines).

MISCELLANEOUS.

GANISTER, best quality for cupolas, also for Steel Works.—ASTBURY SILICA COMPANY, "The Brooms," Park Lane, Congleton.

'Phone: 287 SLOUGH

SELECTIONS FROM STOCK

Four adaptable moulding m/cs	£12 each
3 ft. 6 in. "Evans" Sandmill	£15
4 ft. 6 in. "Evans" Sandmill ...	£20
"Jackman" Rotary Sifter ...	£8
"Herbert" sand whizz r ...	£32
"Jackman" sand whizzer ...	£12
No. 0 "Jackman" Cupola ...	£32
Two "NORTON" D.E. fettling grinders ... ... each	£14

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

DEGASIFIED REFINED PIG IRONS FOR ALL CLASSES OF HIGH-DUTY CASTINGS

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